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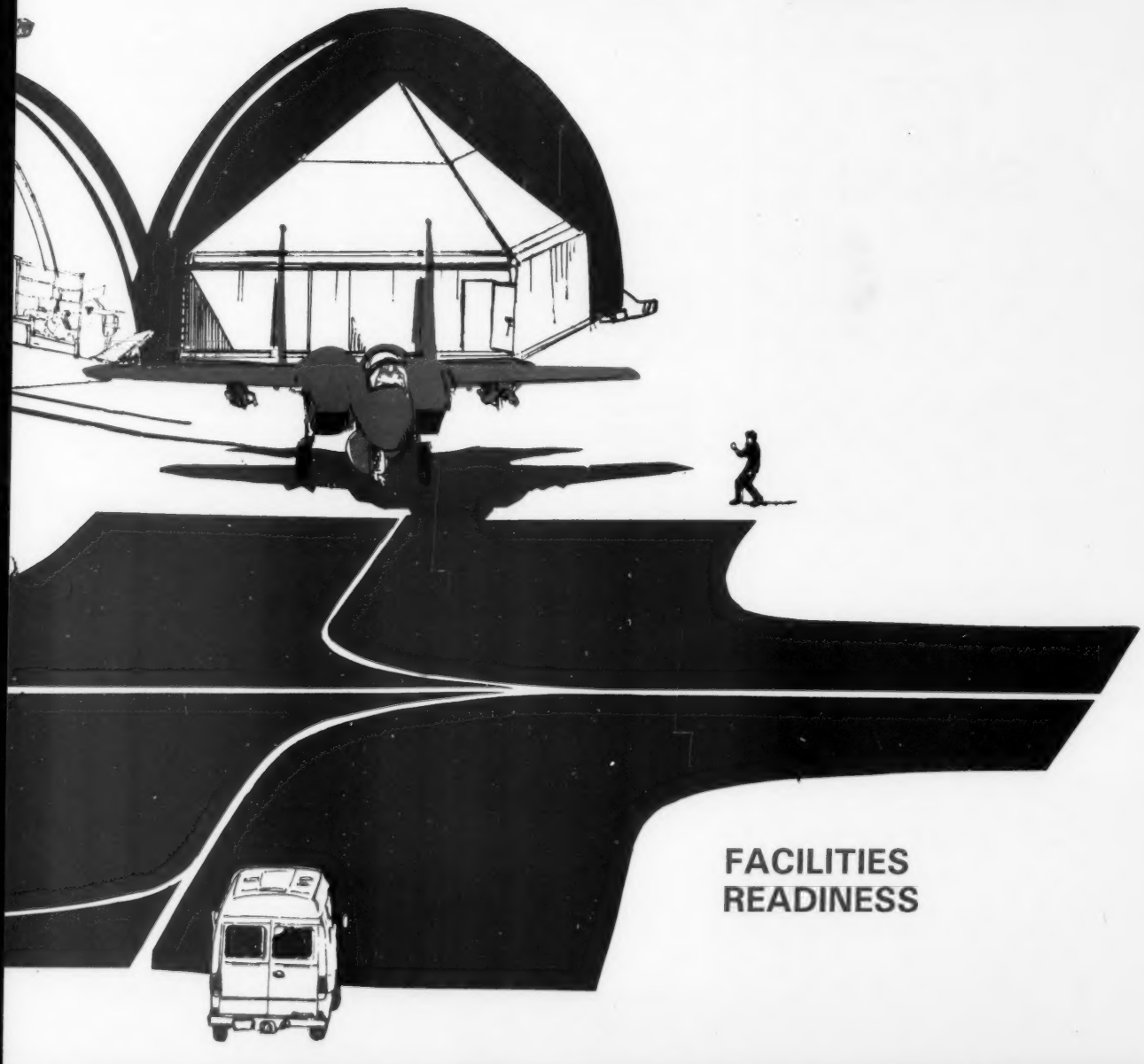


FACILITIES READINESS

From the Director

What price freedom? Not only the freedom to exist as a nation in an often hostile world, but the freedom of the high seas and the airspace above us, the ability to trade with our friends in peace, to attend to the needs of our people.

Freedom is costly. Throughout the world there are artifacts which serve as monuments to national fear of attack and domination by others. There are walls, fortresses and barricades. Modern military artifacts and facilities will likewise find their way into the archaeology.

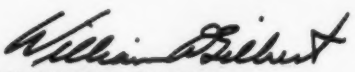
One of the most impressive to me is the Maginot Line, conceived by the French in the wake of World War I. At its time of highest need, at the beginning of World War II, it was easily by-passed by the highly mobile German blitzkrieg.

It stands as a lesson from history for those of us who conceive and develop the facilities necessary to defend our freedoms. We are not in the business of building monuments. We are here to develop functional capabilities which give us the necessary physical foundations from which to operate. Likewise, we are not in the business of providing today the facilities needed yesterday. Such shoring up of the barn door is a costly and ineffective afterthought.

We are military realists. As Engineeering and Services professionals, our job is to project ourselves into the future. Based on our vision, we will adapt the facilities of the past, create the facilities of tomorrow, and do so with but one purpose in mind—giving our nation a solid foundation of efficient, well conceived, designed and fully ready facilities which we can employ when and where needed.

Military facilities are evidences of how we think, and the needs that we perceive. Likewise, they stand as evidence of national concensus and concern. It is important that we present our case for today and tomorrow clearly, realistically, and in a timely way. When the national leadership provides us with the resources we need, it is important that we vigorously guard the public trust, for in the final analysis the confidence of our people must never be disregarded.

This issue is dedicated to the demands of a free nation that we stand ready, in our minds and hearts, to insure that the nation has the capacity—today and tomorrow—to preserve its freedom. Whether your role is maintaining our facilities on the Arctic fringe, designing a new survivable medical facility in the Pacific, operating a food service or billeting function in these facilities, or flying in an airborne command post constantly mindful of every operating facility that we have, you are part of a dedicated team trusted with the readiness of the United States Air Force.



WILLIAM D. GILBERT
Major General, USAF
Director of Engineering and Services

This issue is dedicated to the professionals who plan, build, operate and maintain our readiness facilities.

engineering & services

Air Force
Engineering and Services
Quarterly

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FEATURES

4 • Facilities Readiness: An Interview with Maj Gen William D. Gilbert
8 • Operators and Engineers: Readiness Partners
13 • Survivable Medical Facilities
15 • A Mission of Food
20 • Engineers in the Air
24 • Low-Level Route
30 • Wartime Survivable Command and Control
32 • The F-16 Beddown at Hahn
35 • F-16 + BAK 12 = BAK 14
36 • The Big Blow Out
40 • Maintaining Top Cover for America
44 • The Ability to Fight and Win

DEPARTMENTS

18 • Worth Noting
22 • Current Emphasis
27 • TECNOTES
28 • CESMETtips
47 • Survey

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FACILITIES READINESS

An Interview with Maj Gen Gilbert

INTERVIEWER: General Gilbert, how do you define "facilities readiness?"

GENERAL GILBERT: Even though the idea isn't new, the phrase is. For many years, to quote Mr Perry Fliakas, "if it didn't fly or shoot, it didn't get much attention in the Department of Defense." He also said, "facilities make readiness." We are talking about far more than simply missile silos or aircraft shelters. We are talking about the readiness of all facilities. The entire physical plant of each service, within the theatre of operations or on the other side of the world from the conflict, must be ready to function during hostilities. Facilities must be ready as much so as the weapons systems and the personnel who defend our nation. The range is all inclusive—communications, maintenance and data processing facilities; warehouses, housing for our forces—all must exist where and when needed, and must be completely usable and not be a burden to be kept so.

INTERVIEWER: What are the penalties of unready facilities?

GENERAL GILBERT: Let's look at maintenance. During hostilities, we will have to live with whatever backlog of maintenance and repair we didn't get to beforehand. Our manpower resources will be involved fully with direct combat support—emergency repair of airfields and expedient beddown construction to support operational units on the move. Imagine the consequences of diverting manpower to repairs not generated by combat, but by age, wear and deferred maintenance. This kind of diversion of resources is intolerable. Here's another example—energy. Every kilowatt, every gallon of fuel, every alternative producer of energy will be spoken for. Energy inefficient facilities will greatly increase the stress on the system, making us choose between supporting our combat forces and supporting our own antequated and wasteful facilities. I can forecast that there is going to be a considerable awareness then that "what is not there, won't be." It will be too late to provide it. At that time, those facilities which can function effectively with the least energy will not only be supporting our mission better, but not penalizing the abilities of others to carry out their missions.

INTERVIEWER: Is there a shift in philosophy driving our concern with the readiness of facilities?

GENERAL GILBERT: There has been a shift in emphasis and awareness. The philosophy today is the same that it has been throughout the history of the modern Air Force—be ready to fly and fight at a moment's notice. But peacetime concerns tend to make us think of the military establishment in business terms. This same peacetime mindset takes our attention away from the realistic assessment of what we can expect in a wartime situation, and dims our vision of what we need to win. A further extension is to assume the security and integrity of our operating facilities. This, in turn, leads to putting high-technology weapon systems, highly trained personnel, and the sophisticated supporting equipment which we need at large, complex, and perhaps vulnerable main operating bases. Certain conditions of war will make it difficult for man and machine to operate. So, we must think now of facilities which will support operations, and do so in the most adverse of environments. We in the Air Force are particularly sensitive to any disruption of our supporting facilities. We fly and fight from fixed platforms. If you take away our platforms, you limit our abilities to function. Likewise, if you destroy or damage the supporting sortie- generating facilities and systems, it dramatically affects us by denying us the abilities to launch, recover and launch again. So, when people start

"We must be mindful of each person's facilities needs."

thinking about beddown of new weapons systems, they must include the full consideration of facilities requirements, based on wartime needs and conditions.

INTERVIEWER: How would this consideration of facility needs be expressed?

GENERAL GILBERT: First, the necessary facilities must be identified and design criteria established based on location and type use in time for proper and concurrent programming. We must painstakingly avoid planning omissions. I told a group of engineers last spring that it is less expensive to construct a hardened facility from the start than to harden a mistakenly soft facility after the fact. Even though dollars placed against such facilities needs can be high, it is extremely risky and short-sighted having to begin combat operations without hardened facilities. We must include facilities needs in weapons systems development. I mean that the fighter or tactical bomber or missile launch facility must be ready to receive and support the weapon system. I also mean that the necessary support facilities must be treated with the same priority—maintenance shops, energy systems, special storage. We have to make our facilities easily repairable. And, we've got to prevent the damage of corrosion and age, which reduce readiness, require increasingly high repair and maintenance expenditures, and gradually degrade our combat effectiveness.

INTERVIEWER: How can we deal with the complexity of some of the facilities coming on line?

GENERAL GILBERT: In the past, we brought many facilities on line with great faith and many assumptions. Among these were the faith that we could figure it out, and the assumption that when we figured it out we could keep it going. Assumptions are the paving stones leading to hades. It is imperative that we get

"We must include facilities needs in weapons systems development."

contractors to provide the necessary documentation, training and transitional support to insure that our people can operate and maintain these facilities.

INTERVIEWER: What should our goals be?

GENERAL GILBERT: Our goals are survivability, operability, supportability and efficiency. First, we should look at the survivability of our people and facilities appropriate to location, our best guess of what's going to happen in the next war, and weigh these against mission priorities. That is my number one facilities priority. Survivability. Secondly, we have an urgent need to design to the capabilities of the people we have operating these facilities. If it is hardened, efficient, and designed to need, it may be useless if it can't be operated by anyone holding less than a PhD in electronics engineering. Thirdly, we have got to consider logistics. We have got to have spares for our electrical and mechanical systems available, in peace or in war. Fourth, we must design for the best possible efficiency. That means energy efficiency, maintainability and repairability. Underlying each goal is the need to marry the facilities to the needs of the weapons system.

INTERVIEWER: Should weapon designers scale new weapons systems to realistic wartime facilities capabilities?

GENERAL GILBERT: I believe that they had better go one step further. If they intend that these new systems be useful in the nation's defense, they must be designed to the environment in which they must operate — hostile, dirty, rubble strewn, pockmarked, either extremely cold or hot, either very dry or quite rainy. That's the facility that's hard to design for. You don't know in advance where the holes are going to be in the concrete. Likewise, when the balloon goes up quite often we may be on emergency power, with limited water, fuel and other essentials. Systems which require a pristine environment may not be worth much. It's going to take a concerted effort by both parties, the weapons systems design community and engineering and services. Let's take a look at our most sophisticated system and our most valuable resource—the human being. We must be mindful of each person's facilities needs. We need to shelter them, feed them, have the capability to treat them if they are injured or wounded, and the personal support necessary to insure that they can safely operate without unnecessarily cumbersome, awkward and unsafe personal gear. Let's look at our great enemy, fire. We must ensure that our facilities have the most reliable fire suppression systems built in; that our facilities are designed away from combustability and flammability. When fires do occur, we must protect our weapons systems and personnel against the ravages of devastating heat and oxygen deprivation. We are talking about a total package of considerations. The weapon system must be pro-

jected into the middle of the most likely operating environment. The facilities likewise must be projected there to support both it and the people who operate and maintain it.

INTERVIEWER: What about the facilities at home? How do they relate to readiness?

GENERAL GILBERT: In many ways. First, some are old and inefficient. They consume repair money, operational money, extra manhours, and frequently penalize readiness. Secondly, some have been adapted over and over again to new uses, each time sacrificing design and engineering standards. Thirdly, the utilities support in many cases is deficient. And finally, interior operating systems are often decades old. Each condition penalizes the Air Force. Our response here in the Continental U.S. is compromised, and valuable time and effort is ablated just keeping facilities going. So, what do you do about it? At the outset, you must know how much inefficiency and incapacity are costing you. That's where your argument begins. You can frequently prove your case to rebuild or renovate with good hard dollars and cents arguments based on research. One of the best models is over in the Logistics Command. They have been through two iterations of a modernization plan which is based on removing costly old facilities and replacing them with efficient new ones. They are heavily industrialized and their costing systems make it easier to identify need. But it is an approach that could be valuable elsewhere. We are best served with a planned update program each year. This program means having the foresight and management abilities to put our needs into the POM. This is how we get the money for any given year, and our overall goal is keeping the Air Force physical plant modern and totally supportive of the Air Force mission. Now, why must our domestic facilities be so efficient

"It (facilities) may be useless if it can't be operated by anyone holding less than a PhD in electronics engineering."

in wartime? Because they're going to be used and operated with many of our people deployed somewhere else!

INTERVIEWER: Energy is at the heart of much of our contingency planning. How do you perceive the challenge?

GENERAL GILBERT: You can add mineral resources to energy. We are concerned with freedom--the freedom to trade with nations throughout the world using the airways and waterways, with our trading partners uninhibited by foreign domination and oppression. This has caused us to take a serious look at parts of the world not considered in our active contingency planning before. And in many cases we're starting from scratch. No one recognizes the importance of energy and mineral resources more than the Soviets. They want to control the two treasure houses of the world upon which the West depends--the Persian Gulf area and the wealth of petroleum reserves there, and Africa with its huge mineral resources. We must be determined that these do not fall under the dominion of the Soviet Union.

INTERVIEWER: How do facilities relate to the flow of oil and minerals into our national economy?

GENERAL GILBERT: If we are to rapidly deploy to defend the freedom of trade routes, of nations to trade with us, or to stabilize a threatening conflict situation, we must have facilities. We have programmed facilities into several nations which have offered us places where we can develop or build. These facilities will greatly improve the response and deployment times and the effectiveness of our forces if we must project them into a new contingency arena. This translates into a viable and believable force, so important in deterring unwarranted invasion or takeover in these critical areas of the world.

INTERVIEWER: We have heard the goal expressed that the United States should become "energy independent." Can the U.S. become energy or mineral independent?

GENERAL GILBERT: Yes, and we can help greatly in achieving this independence, if we design away from the energy resources which we don't have in abundance, and design toward those which we either have or can reasonably expect to have. Yes. If we design away from certain rare minerals and toward those that we have in plentiful supply. Yes, also, if we reutilize mineral-based materials recovered from waste. Years ago, we could say that we were independent with some truth because we never were really threatened with the lack of anything. I recall when our awareness of dependency was raised by the two oil crises. In the same manner, our industries, upon which we depend so much, are being faced with new awareness of our dependencies upon other nations, many of them in the Third World, for titanium,

manganese, gold, diamonds, cobalt, uranium, and other rare metals. As a fighting force, the Air Force is uniquely dependent upon both petroleum and minerals.

INTERVIEWER: Can we depend on materials which we now need being available in times of international stress and emergencies? What does it take to maintain free world trade?

GENERAL GILBERT: Protecting our trading partners requires carefully scaled facilities planning to support the force projections required to achieve stability in an uncertain world. We can depend on free access to the mineral and petroleum-rich areas of the world in a direct proportion to our readiness to protect our interests and those of our partner nations. That readiness must be backed with the forces, facilities and logistics systems to protect our interests.

INTERVIEWER: How do our major facilities developments relate to readiness?

GENERAL GILBERT: The biggest, the M-X, is in the process of undergoing integration into a new basing mode. We of Engineering and Services are professionals, and we will support the national leadership in any basing or deployment decision in the most professional manner. Whatever the decision, we will treat it urgently, because land-based missiles are a part of the strategic triad. It is important that we create a survivable missile system, matched to the facilities requirements, in order to force any potential enemy to allocate a portion of his offensive and defense hardware to this option in our arsenal. Our Space Shuttle at Vandenberg is progressing, and this will greatly facilitate the process of placing, and perhaps removing and repairing communications satellites. Our Air Launched Cruise Missile facilities have been programmed for key Strategic Air Command bases. Our Ground Launched Cruise Missile program, jointly funded by the U.S. and NATO, will be a major program in five nations. ASTF, our 100,000-foot simulator for testing propulsion systems at Arnold Air Force Station, is a very expensive facility. But, in providing these essential sophisticated facilities, Engineering and Services people must have one motto: "Communicate, Coordinate, Cooperate." There are millions of details in these large projects. They must be carefully considered. Once considered, weighed and judged, they must be communicated to the proper people. Then, you've got to work as a team. No matter how "right you are" you're wrong if your costs are excessive.

INTERVIEWER: We have developed facilities in Israel and Saudi Arabia. Will these contribute to our readiness?

GENERAL GILBERT: On one hand, we are responding to a request from Israel to help them build two bases in virgin territories in that country, which will enable them to beddown their forces from the facilities which they have agreed to give up as a part of their accord with Egypt. On the other hand we are working with a friendly nation to improve main operating facilities needed to support that nation's long-term military needs. The government of Saudi Arabia is paying each dollar required for this construction. In both cases, we are drawing upon our expertise as military engineers to manage major programs. In neither case can we assume a contribution to our specific readiness goals, because each facility is in sovereign territory. We have responded in the dimensions prescribed. Likewise, we will abide by the limitations of these agreements. Our agreement was in each case to provide the most professional possible contribution to satisfy the construction requirements of friendly nations. And, we're doing it well. Let me add a major benefit. We are learning a great deal about this region of the world, and the abilities of our people and those of contractors to get the job done in this arid, hot area of the globe. But, being friendly nations, it is quite possible we can benefit from these base facilities in time of need.

"This program means having the foresight and management abilities to put our needs into the POM."

INTERVIEWER: What single word would you want to communicate to Engineering and Services people in regards to facilities readiness?

GENERAL GILBERT: Urgency. There must be a sense of urgency. And, there must be a sense of vision. We have to project ourselves into the time and place that we're thinking about, and put our professional backgrounds to work. We have got to figure what we need for the future. And, we've got to communicate constantly among ourselves. The Air Force of tomorrow must be built upon an integrated approach in which the weapon systems, the facilities, and the people who operate them are compatible and capable, cost-effective, energy efficient, and reliable.

By Lt Gen Philip C. Gast

Working in the joint arena and dealing with our international security concerns impresses one with the feeling that the world is getting bigger, not smaller as is commonly heard. The giant strides in the communication and transportation fields coupled with economic and natural resource considerations have turned our attention to cities, countries, and regions once too remote or culturally unknown to foster our support or interest. As our sphere of interest expands so also does our need for greater deployment and employment flexibility. Almost daily, new engineering challenges arise because we have a new geographical interest or because technology has created the need.

The military engineering community faces some great challenges as our interests shift around the globe from Egypt, to Israel, Saudi Arabia, and Diego Garcia. We are going to have to be innovative and most of all responsive. Lately we haven't had the luxury of time to plan, organize, and build. As witnessed in Southwest Asia, we must be ready to move rapidly. In the next crisis chances are we won't have time to create new methods or facilities. We won't have time to create new ways to make runways bear greater stress. We won't have time to develop new rapid assembly port facilities or noncorroding cargo handling equipment. The point is that the engineering community (both military and private industry) must be ready even to support the unexpected developments. Our potential adversaries continue to export international instability at an alarming rate, to all corners of the world. Additionally, they have the advantage of picking the climate and geographical surroundings in which they will operate. They can modernize their force and create in advance the facilities and equipment they will need.

We, on the other hand, not being aggressors, must be ready for all environments and terrain. Our task is made more difficult by our free enterprise, democratic system where, in peacetime particularly, defense needs compete for resources along with all other needs. Unless the public is convinced there is clear and imminent danger, it is very difficult to rally the resources necessary to prepare for all possible conflicts. As has been the case for many years—essentially since the end of World War II—the most present and menacing military threat to the United States remains the massive and continuing growth of Soviet military capabilities. Were the situation strictly a "one-to-one" contest—that is, the United States in direct and single confrontation with the USSR—we might not be as burdened as we are. Unfortunately, however, through the use of surrogates the Soviets continue to spread unrest around the globe. They also have maintained a steady military modernization program within the Warsaw Pact, and, as evidenced by their invasion of Afghanistan, are not above active military adventurism.

Against this background, the United States continues to adhere to the principal that the primary goal of its military policy is deterrence—demonstrated by a clear intent to fight, if necessary, and the ability to retaliate or defend successfully against both conventional and nuclear attack. To ensure a solid foundation for this policy, four general underlying objectives or requirements are clear. We must

1. Continue to build greater military strength.

2. Revitalize collective security by persuading our allies to assume their fair

share of the common and growing defense burden.

3. Ensure flexibility and a capability to respond to threats in any part of the world.

4. Continue to pursue adequate arms control agreements to reduce the military threats arrayed against us and to enhance stability.

Given our policy of deterrence, and the underpinnings just described, such have credibility only if we have forces that are ready to respond and a potential aggressor knows it. Additionally, he must know that our forces are constantly being improved and must perceive that we will, in fact, employ them. In this regard then, there are only two essential questions to be asked should war be necessary, when assessing our military forces:

1. Are they ready to go to war?

2. Will they be able to fight successfully?

The answer to both questions is an emphatic, "Yes!" That is not to say that we do not have problems. That is not to say either, that the Joint Chiefs of Staff, as a body, do not have concerns about readiness deficiencies. Taken together, they limit the total capability of the forces and especially the general purpose forces. But our forces are, in fact, capable of generating significant combat power and any potential adversary must be prepared to pay a very high price should he attempt to engage them. We must be realistic about the worldwide U.S. military force posture. The United States may be the only true free world power today—that is, the only nation that really does have worldwide interests and makes an active effort to attend to these. Our interests involve not only directly supporting the U.S. economy, but the support of allies and other friendly nations as well. The example of our presence in Southwest Asia is a clear signal to friend and potential foe alike that we fully intend to ensure the free flow of Middle East oil to fuel the world economies. Indeed, it is not difficult to imagine a day not too far in the future when military forces' primary function might be to keep worldwide lines of communication open to ensure the free flow of a wide variety of strategic and critical resources. There are uncertainties—

- **Where will the United States have to employ forces?**
- **What force level will be required?**
- **How rapidly can the force be deployed?**
- **Can the force be deployed with the systems and support that will enable it to accomplish its mission?**

OPERATORS & ENGINEERS: READINESS PARTNERS

Because of the Soviet Union's continued willingness to underwrite unrest, and as exacerbated by various other international instabilities (the war between Iran and Iraq for example), the United States must maintain a flexible posture that permits a response capability in virtually every corner of the world. To this end we already have forward-deployed forces in Europe, the Western Pacific, and the Indian Ocean/Arabian Gulf (Southwest Asia), at considerable expense to and strain on our available assets. This we hope will provide a clear signal of our intentions to any potential adversary. In addition, we have established the Rapid Deployment Joint Task Force (RDJTF) and assigned it responsibilities for contingency operations in Southwest Asia—a further demonstration of our determination.

Despite these commitments, we do not presently have all the capability we would like and, in some specific cases, not all that we might conceivably need. Wide-ranging deficiencies including shortfalls in unit equipment,

shortages of repair parts, inadequate maintenance, and lack of medical support required for sustainability are among current problems.

Moreover, as we assess these deficiencies and examine the production base, it is clear that there is an increasing need for a more responsive capability to provide the means to fight—not only the mechanics of war and the necessary sustaining items, but the materials and capability to transform distant unimproved real estate into supporting facilities. Here the engineers, with the specific reference, for example, to the Navy's "Sea Bees", and the Air Force's "RED HORSE" units, play an essential role in U.S. force projection. So, too, does American industry. Without a healthy production potential with a national mobilization capability to respond rapidly to changing requirements, modern military force projection may not be possible. In addition, there are equally important force projection needs involving deployable packages that can provide what we might term "instant combat environments," both for combat systems and their supporting equipment. We would definitely not want to build large numbers of "everlasting monuments" for our deployable forces and would desire to use existing facilities to their maximum potential. This desire, of course, is highly dependent upon the host nations' cooperation and the prevailing international political situation. Nevertheless, the necessity for being ready to bring our own ball and bat and the capability to rapidly set up a portable stadium are obvious in today's world.

Planning

To achieve readiness requires extensive planning and analysis. Experience from a variety of sources gives us the necessary dimensions of the response needed. We can look into future needs based on responses of our forces in conflicts of the past, and recent engagements of combat forces of other nations in regions of potential crisis. Our series of major field exercises and command post exercises have flexed different combinations of muscle. TEAM SPIRIT, conducted in Korea, and REFORGER, conducted in Germany, provide us valuable insight into our abilities to coordinate the capabilities of allied forces. RED FLAG and BOLD EAGLE constitute valuable laboratory demonstrations equal to the highest levels of combat training we can employ. Perhaps one of the most important is the recently completed BRIGHT STAR exercise in Southwest Asia.

The challenge to the Engineering and Services communities is to sift carefully through the after action reports and the experiences of our people, to determine our true abilities to respond. Intense review and profiting from past challenges will enable us to more effectively provide the operating support necessary to sustain any future effort. The range of concern is very wide. What airlift is needed? How can we minimize airlift requirements? Air Force RED HORSE effectiveness, for instance, will benefit greatly from recent decisions to pre-position heavy equipment in advance. Additionally, locally available foodstuffs minimize transportation requirements, but in most of the regions of concern to us food is in short supply. Can we cope with the demands our force projections will place on local environments? Availability of water which can be made readily potable is a critical problem in many areas of the world. Can we protect our deployed forces at their operating facilities? Battle damage to our facilities denies us use of runways and takes people away from the task of supporting sorties.

While considering all of these factors in the readiness equation, we must not ignore the requirement to provide the appropriate mix of support facilities. There must be a proper balance among our military construction efforts for installations, including advanced fixed facilities that can be rapidly opened to support our deployable portable facilities; and, the rehabilitation and reopening of existing but abandoned or reduced-use facilities. In regard to the latter, it is a particularly important requirement that we maintain detailed and up-to-date surveys and inventories of such facilities to expedite their reopening should our force projections carry us into areas where such would prove both beneficial and economical.

Cooperative Effort

This makes critical the need for cooperative efforts among the operators, civil engineers, the research and development community, and the procurement experts. Their challenge is to provide systems that can be expeditiously and economically produced to function in the field and give our forces the capability to deploy, fight, and win. This remains a clear concern and challenge to all.

How well are we prepared to carry out our assigned missions and assume international responsibilities? Better than many may give us credit for, especially if one concedes that in almost any military undertaking we would certainly be responding in a coalition effort against an adversary who would have problems similiar to those we face in projecting and sustaining forces.

Our deployed forces, with limited exceptions, are in a continuing high state of readiness and, with varying amounts of difficulty, depending on location and situation can be augmented by forces in the United States to further enhance their readiness and combat capability when required. Looking at the total force, our military capability continues to be dependent on a variety of important factors:

- **Force structure—Do we have the right kinds of units sized and organized to respond?**
- **Modernization—Do our forces and their combat systems have the proper equipment to actually meet the threat?**
- **Readiness—In this context, do we have the ability to deploy and employ our forces effectively without unacceptable delays?**
- **Sustainability—Once committed, can we provide the wherewithal for our forces to fight and win?**

In some of these areas we are not where we would like to be. This is partly a function of the long lead times required to put new systems in the field. At least in part it is due also to the massive expenditures involved in the Viet Nam war which had the long-term effect of reducing funds for modernization in the ensuing years while we concentrated on immediate readiness needs in order to fight that war. For example, the U.S. Air Force incurred losses approximating 2,300 tactical aircraft during the Viet Nam war—a loss not easily replaced on a peacetime production schedule. Our stocks of pre-positioned munitions in Europe dipped to dangerously low levels by the end of that war—although—we have made substantial progress in eliminating that problem between 1976 and 1980.

The Engineer's Role

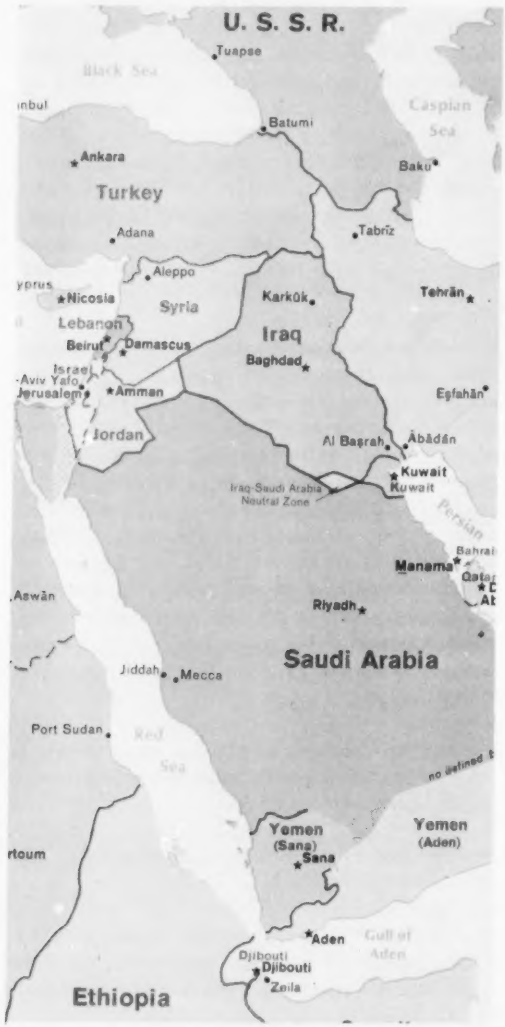
How does the military engineer fit into this? As alluded to earlier, engineers must actively participate in the identification of power projection requirements and in the development of the means and facilities to rapidly achieve such projection. The military engineer is vitally important and must be a constant player in helping to develop the methodology and machinery to rapidly deploy, install, and operate expeditionary logistic support installations. This includes for example, POL, water, and supply distribution—as well as sea and aerial ports through which to move the combat equipment. Likewise, the military engineer—indeed, the entire engineering community—must contribute to continued and enhanced military readiness by active membership on the team of designers, operators and R&D personnel who develop the deployable base packages and their components and that which is necessary to repair those packages. Far in advance of new weapon system development, every effort must be made to ensure that the facilities' needs—to maintain, launch, recover, repair and relaunch—are considered as part of our acquisition's design. Further, tactical weapons development must be consistent with what we deploy and the facilities to which we deploy.

While we need deployable packages, we also must have an increased capability to deploy. We still do not have the totally adequate lift capability to project all the forces we might require in a time-sensitive crisis. While this applies to both airlift and sealift, at least for the near term, it is most significant in the area of airlift since so much of the U.S. military strategy in Europe, the Pacific, and Southwest Asia is predicated on the rapid augmentation and resupply of forward-deployed forces during crisis situations. Over the longer term, the prospects for enhanced rapid response capability look promising.

- **We continue to ask our allies for more definitive and detailed host-nation support.**
- **New fast container ships will be added to our lift force.**
- **The POMCUS program—prepositioned overseas material configured to unit sets—supporting the Army's reinforcement of NATO, continues.**

- **We have placed in Southwest Asian waters the first near-term prepositioning ships loaded with equipment for Marine and Air Force operations.**

To ensure that we stay ahead of the power curve, we still need the new, long-range, versatile cargo aircraft. As well, we need a better fix on mobilizable assets [e.g., Civil Reserve Air Fleet (CRAF) and merchant ships under U.S. control] that can be employed during crises to project U.S. power. Finally, we must ensure that we have a proper balance among readiness, sustainability, modernization, and force structure efforts so that available resources are appropriately allocated to support national objectives.



Summary

In sum, the United States possesses significant combat capability with the resources to project and sustain that capability in virtually any part of the world. The level of effort that could be maintained in a force projection role and the period of time during which such could be sustained, would be dependent on a variety of factors including location and accessibility, availablity of secure lines of communication, host-nation support, assistance from U.S. and friendly-nation support facilities, warning time, the amount of lift available, and competition among or between separate contingencies for the available resources.

In the final analysis, any power contemplating a military confrontation with the United States should be prepared to pay a high price and fully expect casualty rates—to fixed installations, equipment, and personnel—far in excess of what, thus far, has been thought of historically as acceptable.

The Air Force Engineering and Services community plays a key role in the creation of a strong national defense, particularly in an active defense where forces are projected. They must be innovative, aggressive, and above all, in on the ground floor— whether for the creation of a new high technology weapon system or a plan for rapid projection of forces into a remote area of the globe. The value of the engineer to commanders was recognized early in the history of civilization and many battles have been won due to an engineering feat. As tactics and systems become more sophisticated, this value can only increase.

E&S

Lieutenant General Philip C. Gast *(USAF) is director for operations, Joint Staff, Organization of the Joint Chiefs of Staff, Washington, D.C. He received a bachelor of science degree from the University of Missouri in 1952 and was commissioned through AFROTC. General Gast received a master's degree in military science through the Army Command and General Staff College in 1965, and completed the National War College Washington, D.C., in 1970. A fighter pilot, he has held key assignments in Tactical Air Command, Air Training Command, Southeast Asia, U.S. Air Forces in Europe, Air Force Logistics Command, and Iran.*

Making sure you can yell "Medic!"

Survivable Medical Facilities

by Maj Gordon W. Best

Medical care is one of those assumed provisions. It's always there and normally in proximity to your work. It's even more taken for granted and almost forgotten by the healthy military member. But, what happens when we go to war? All of a sudden someone yells, 'Medic!' only to be told that the medical facility was destroyed. Your mission and life may depend on the continued existence of medical care and the survivability of the medical facility.

Peace and War

For years we have designed overseas medical facilities as if we were locating them in Anywhere, USA. We gave thought to architectural, environmental and, lately, energy items but missed the real issue—will it be operational after the base is attacked? This issue has given way to a new evaluation of how we design and site medical facilities overseas—each being different in size, mission and threat. What applies for one may not be the answer for another. The wartime goal is to maintain a medical facility and return casualties to duty or evacuate them as soon as possible.

The Air Force is unique from the Army and Navy since the focal point of our operations is the runway. The other armed services have far more flexibility in planning wartime medical care. In fact, their mobility plans are just the opposite of our fixed location concept; but, can a fixed medical facility be designed to perform both peacetime and wartime operations?

A medical facility contributes to the Air Force mission by maintaining the highest degree of personnel combat readiness in peacetime to assure effectiveness in wartime. The peacetime mission is best accomplished in efficiently arranged, easily accessible facilities having pleasant and attractive surroundings designed to support proper patient management. In wartime, this same facility must be able to rapidly accommodate large numbers of casualties and return them to duty or evacuate them as rapidly as possible. With the recognized potential threat of chemical weapons, the advantages of peacetime accessibility become tremendous wartime liabilities. How do we delicately balance these needs into a building design without losing sight of the peacetime patient or the wartime casualty?

Concepts

In the FY 83 medical program, two projects are leading the way in answering the wartime/ peacetime questions. One, a replacement clinic for RAF Alconbury, has taken a very simple approach—site the medical facility off-base away from the area of threat. During wartime this philosophy is sound if the surrounding countryside is fairly secure and patient movement will not be hampered. Physical location is Alconbury's survivability factor. The second, an 87,900 square-foot replacement hospital for Osan AB, has a more complex philosophy. Off-base siting was not an option and we didn't want the high costs associated with semi-hardened or hardened construction. We felt a technique of 'passive protection' combined with chemical protection would provide the survivability factor for Osan.

Major Gordon W. Best *is the design manager in the Facilities Division. Air Force Medical Service Center, Brooks Air Force Base, Tex. He earned his bachelor's degree in architectural engineering from Washington State University and is a member of the Air Force Medical Service Corps.*

"Passive protection" to us simply meant bury, berm and reduce perimeter penetrations. The inherent sizing and quantity of this type building structure offered an extra degree of protection for little additional cost. The building site was very limited and a two-story structure was required. So, we just decided to bury one floor. The underground concept and upper level berming also provides good potential for energy conservation.

Our first problem was to divide the hospital's departments between two floors with all the critical wartime functions on the lower level, but to still have a functional facility. We assumed the upper level of the building was expendable during wartime. Fortunately, a scheme was developed to minimize peacetime patient circulations and reduce functional compromises.

Emergency Need

Special attention was also given to expanding the bed capacity for wartime. The facility will have 30 beds during normal peacetime operations. However, when needed, the capacity can be expanded to approximately 230 with the additional use of litters and stanchions which will allow double and triple decking of patients. Open bay wards will develop from reconfiguration of soft spaces such as material storage and nursing unit open areas.

Chemical Protection

Another significant feature is the chemical protection/ filtration and over-pressurization of the lower level to insure a shirtsleeve working environment for medical staff. Normal access to the lower level is by covered driveway for emergency vehicles. Stairs and elevators would be sealed. Access and exit for people on foot or litter will be provided through air locks and a decontamination function. Once patients leave the decontamination process, they will be sent directly to emergency service or surgical service.

Early hurdles were splitting a facility between two floors and providing vehicular access to the lower level without compromising the building integrity. These hurdles appear to be solved as we approach concept phase completion. The next set of hurdles is to establish wartime operation guides for use by the facility. These guides will outline the wartime plan concerning efficient triage of patients, bed expansion and storages of litters/stanchions, food service methods, staff accommodation, etc. As an architect fine-tunes a design with details, we must also fine-tune the concept of operation if we hope to have a successful building.

These two projects are a small contribution toward assuring medical facilities will remain operational in wartime. The facilities division is committed to the design of survivable facilities overseas and realizes the important role they play in assuring mission success.

A MISSION OF FOOD

for today and in the future at NLABS

by Capt Steven F. Berendt

The same laboratories which developed the foods used in the space program are working on nutritious liquids which can be taken through the drinking tube of the M17A1 gas mask. These liquids will help Air Force combat personnel maintain their effectiveness while working in a contaminated environment. Other scientists are perfecting a dining hall mini-computer for testing in 1982 which will relieve food service supervisors of tedious paper work and provide a whole new world of management information for planning and analysis. Still other scientists and engineers are pushing the limits of heat transfer technology to provide lightweight, extremely efficient ovens and griddles for our deployable field feeding systems.

This pool of scientific, engineering and management system expertise is located at the United States Army Natick Research and Development Laboratories, known as NLABS to its friends. NLABS, located just west of Boston, Mass., is the performing laboratory for the DOD food research, development, testing and engineering (RDTE) program, an all-services integrated effort to develop and refine all facets of military feeding.

If you wonder why the food RDTE program can't just adopt the findings of the civilian sector, including industry and university work, ask yourself: "When was the last time a civilian company tried to develop a complete meal which could sit in a hot warehouse for three years with no ill effects?" Or maybe you remember when a university was last interested in or funded to find out what effect toxic agents have on food packaging materials. Militarily unique food service requirements demand that a separate and dedicated program be instituted to confront the military's feeding mission today and in the future.

NLABS is manned by about 1,100 civilian scientists, engineering and support personnel

plus 100 military. Only about one-quarter of these people are dedicated to the food program since NLABS also is responsible for all airdrop technology and engineering, all tactical shelters and tents, Army uniforms and individual load carrying equipment.

The food RDTE program was established by DOD directive in 1970 and its operation is governed by a Joint Service Regulation. The Air Force designation is AFR 80-52. The Air Force, Army, Navy, Marine Corps and Defense Logistics Agency convene a joint formulation board (JFB) each year to ensure that they all get their required share of the NLABS effort. The JFB representative of each service and DLA vote at the joint formulation board meeting to establish the level of funding each specific project will get and the integrated priority of the projects. Once this prioritization and approval process is complete, the entire food RDTE program goes forward to the Undersecretary of Defense for Research and Engineering for approval. From here, it is included in the Army's budget and eventually subject to Congressional scrutiny like all programs. In fact, in FY 81, a Congressional directive held up funds for work on the feeding system required by the Air Force ground launched cruise missile. This delay was only temporary and no delays are expected for any FY 82 research funds.

Air Force Engineering and Services convenes a research and development requirements council annually in February prior to the JFB meeting. The members of the council review the Air Force requirements for food service research and development and establish the priority of Air Force projects as they will be submitted to the JFB. The other military services also have prioritization procedures.

Research, development and engineering projects are budgeted at over $1.1 million in FY 82. There is a wide diversity of effort being conducted. As a result, the Air Force and the other services each appoints a full-time representative to a joint technical staff (JTS) at NLABS to provide an on-scene liaison. JTS is composed of Air Force, Army, Navy, Marine Corps and DLA officers. It is a pivotal body in the day-to-day conduct of specific military project research and development. Each JTS member is responsible for monitoring the progress of work, advising and expanding on the requirements from their service and keeping their service advised on all facets of the food RDTE program.

As you can imagine, keeping tabs on seven or more complex, long-range R and D efforts would

NLABS located in Massachusetts, west of Boston.

be impossible without a comprehensive technical plan of action. Before research and development work is begun, Natick scientists consider the Air Force requirements put before them in the light of current technology, the time available to do the work and the costs (in man years and dollars) to complete the work. Using this orientation, they create a plan of action which is reviewed by the Air Force JTS member, Air Force Engineering and Services Center personnel, as well as concerned staff elements of the major commands. Finally reviewed and approved, it becomes the blueprint for the effort. Progress can be tracked as milestones are met and blocks of the project are completed. To keep

work going, as projects progress through their life cycle and approach the prototype and production engineering stage, the requirements documents become the formal statements of need (SON) and required operational capabilities (ROC).

The current Air Force project that is the closest to completion is one which has seen a comprehensive update of our mobility feeding system, Harvest Eagle. This deployable, soft shelter feeding system is benefitting from numerous initiatives, including all new shelters developed at NLABS, a centralized fuel supply for the kitchen burners (which are the heart of the system), and several other equipment updates. With this equipment revamping has come a complete manpower reevaluation and system analysis. The goal to reduce manpower 30 per cent while retaining or improving the performance of the system appears to have been achieved based on field tests, including one at operation TEAM SPIRIT 81 in Korea.

Gas mask drinking tube feeding research, mentioned at the beginning of this article, is also breaking new ground in the area of computer modeling of toxic agent levels. Using more detailed analysis than even the Chemical System Laboratory at Aberdeen Proving Grounds, Natick scientists are looking at the agent exposure levels possible at our bases in Europe. This data is being used to help develop procedures for decontaminating or perhaps even hardening our food processing and storage facilities against nuclear, biological or chemical contamination. This research will have impact on other areas of base operations and its application will not be limited to the food program by any means.

NLABS is also developing a mobile kitchen to support deployed ground launched cruise missile teams. They are also in on the ground floor of the M-X project having been tasked to develop the food service support for the security alert facilities and the small groups of Air Force personnel who will support the widely dispersed missiles.

NLABS will soon be addressing continuing requirements to feed personnel hot meals away from the dining hall. Alerts, aircraft surges, security requirements and other commitments of sparse manpower sometimes prevent personnel from getting to the dining hall to eat. After actually defining and categorizing our shortfalls, NLABS will tailor systems which can meet the mission efficiently. Past solutions to this problem have been created by individual unit initiatives and sometimes even non-food service personnel. The Air Force major command deputy chiefs of staff for Engineering and Services, at their annual requirement council meeting, were so interested in solving this problem they moved it up to a FY 82 effort. Funding for the study comes from operations and maintenance funds.

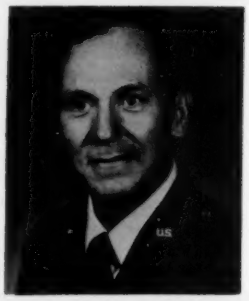
This brief overview cannot begin to relate the benefits the Air Force feeding systems realize from the DOD Food RDTE Program and Natick Laboratories personnel. We sometimes lose sight of the progress we've made in food service because we do not have the memory of wormy hardtack and salt pork or later developments such as spam and dehydrated eggs to give us the proper perspective. We cannot afford to take food service progress for granted partially because of the efforts of the U.S. Army Natick Research and Development Laboratories and the DOD food research, development, testing and engineering program.

Captain Steven E. Berendt received a bachelor of science degree in history from the Air Force Academy in 1972. After assignments as assistant commissary officer at Lowry AFB, chief of services at Thule AB, Greenland and chief of services at Camp New Amsterdam, the Netherlands, he attended Florida International University under AFIT receiving a master of science degree in hotel and food service management in 1980. He is currently assigned to the Air Force Engineering and Services Center with a duty location at Natick Labs, Mass., where he is the Air Force representative to the joint technical staff of the DOD food research, development, testing and engineering program.

worth noting

☆☆ PROMOTED ☆

Maj Gen
Clifton D. Wright Jr.



Col Joseph A. Ahearn

Col George E. Ellis

BABY SITTERS SAVE LIVES

Finding a good baby sitter just may be a bigger problem for a military family than for the average household in a civilian community.

What to do? At Robins AFB in Middle Georgia, the problem is solved. Thanks to the continuing baby sitter fire safety program, the base Youth Center maintains a growing list of qualified sitters.

Fire inspector Mike Smith, who has been working with the course from its inception and now heads the classes, says, "The sitter has to be serious about the job. He or she has to really be convinced as we say on the baby sitters' pledge and guide, 'I have one of the most responsible jobs in the world."

Says course director Smith, "We'd like as many kids trained as possible because we think this is an important life-saving educational program." The security police and the health education office echo his words as they schedule their participation in what now seems to be a monthly two-evening program. (Skip Korson, Robins AFB)

GUARD NCO GETS DEGREE, COMMISSION

A former-enlisted second lieutenant was selected to help design new facilities and help make them a reality at Ellington AFB, Tex. Lt Sheila Hooten is assigned to the 147th Fighter Interceptor Group's Civil Engineering Flight. She will work on plans to build and modify Air National Guard facilities there when the unit converts to the F-4 jet aircraft mission next year.

Lieutenant Hooten originally enlisted in the air guard. She is now a resources and requirements officer. Lieutenant Hooten is responsible for helping design the base's aircraft alert facility and other projects at Ellington AFB.

The daughter of a carpenter, she finds the civil engineering field challenging in her civilian job as well. She is employed by the Ressler and Applebaum architectural firm at Houston, Tex., and expects to be fully certified in her profession as an architect soon.

Lieutenant Hooten was born in Conway, Ark. She received her bachelor's degree in 1978 from North Dakota State University in Fargo, N.D.

TEXANS DEPLOY TO ALASKA

One major contribution to readiness training becomes a practical supplement to available manpower.

Alaskan Air Command last year benefitted from a deployment of the 149th Civil Engineering Flight, normally based at Kelly AFB, Tex., which deployed to Elmendorf AFB, Alaska to complete their annual two-week active duty training.

Projects included working on a new visitors center, a parking area, an outdoor basketball court for hospital personnel, working on two racquetball courts in back of the field house, and other neighborly help. Primarily, they carved out 16 new training sites in the woods for base personnel.

Tasks involved asphalt laying, concrete, earth contouring and conformation, laying aggregate, drilling, carpentry, steel cutting, heavy pipe work, trenching, and even chain sawing, axing and hand-shoveling.

While the Texans liked the cool Alaska summer weather, they found the earthquakes unsettling even if no damage was caused. Earlier deployments by the 149th have been to Germany, the Azores, Utah and Oregon.

Lt Col Harold H. Blackshear is flight commander. He said that the summer training deployments help weld the elements of the flight into cohesive teams, and further the development of secondary engineering skills.

Col Richard B. Lewis, 21st CES, Elmendorf, said "These folks have worked really hard in their training program and they are leaving us with some great improvements, and our engineers have been free to work on some other projects."

WPAFB GETS FIRE FACILITY

On-base recurrency training for firefighters at Wright-Patterson AFB, Ohio, is more efficient, safer and productive thanks to a new simulated crash fire fighting facility.

Constructed under a nearly-$500,000 contract by Brumbaugh Construction Co., Greenville, Ohio, the facility consists of a 61-foot diameter tank which stands but two feet above the ground. Filled with water, it is topped with contaminated JP-4 jet fuel (removed from aircraft and not reusable). The fuel is ignited for fire training. A steel aircraft mockup is mounted above the tank.

It is environmentally far better than previous technology, with few particulates and fewer gaseous emissions. Quick shutdown is one feature, with adjustable reflash rates for various type of fires.

Water can be separated after training from any unspent fuel. The resulting pure water is then sprayed over a wide area for percolation into the ground. Unburned fuel is stored for later use.

The facility is similar to one constructed at Chanute Technical Training Center, Chanute AFB, Ill. (Charles F. Brydia, 2750th ABW, Wright-Patterson AFB, Ohio)

Engineers in the air

by Captain Jeffrey L. Tyley

Just imagine this situation: A nuclear confrontation has just occurred between the United States and an aggressor nation. Numerous airfields and command posts have been destroyed and deadly radioactive fallout is spreading across parts of the nation. Meanwhile, the bomber and tanker forces are returning. The question is asked: Which airfields are operational and free from harmful levels of radiation? Who answers these questions? The Engineering and Services officer aboard Strategic Air Command's airborne command post, that's who.

A unique opportunity exists at SAC headquarters for young officers assigned to the deputy chief of staff, Engineering and Services, to gain operational experience by flying as battle staff crew members aboard SAC's airborne command post.

The requirement started in early 1980 when SAC took delivery of the first modified Boeing 747B aircraft designated the E-4B. SAC is the Air Force single manager for the E-4 aircraft, including both the A and B models. The A model has been in service several years and presently supports the office of the Joint Chiefs of Staff, National Emergency Airborne Command Post (NEACP). The B model specifically designed as an advanced airborne command post, supports both the NEACP and SAC airborne command post missions, coined "Looking Glass." The main operating base for all the E-4 aircraft is Offutt AFB, Neb.

The mission of the airborne command post is to assume control of SAC's strategic forces should the SAC underground command post become inoperative. The airborne command post is fully equipped and ready to provide continuous command and control of SAC's resources from the air, including launching the missile force, directing worldwide bomber and tanker missions and determining points of safe recovery within the continental United States.

The mission is generated each day, three times per day, using either an EC-135 or E-4B aircraft. Before the returning aircraft can land, a follow-on, or relief aircraft, must be airborne and fully ready to assume control. This continuous mission has been going on everyday since 1961. The airborne command post recently reached an aviation milestone by completing 20 "continuous" years of accident-free flying. This amazing achievement comprised over 20,000 missions and 171,200 hours of flying time.

The airborne command post missions include, in addition to the normal flight crew—called the "front-end crew," a "back-end crew," consisting of a battle staff and communications team all directly under the control of a SAC general officer, designated the airborne emergency actions officer (AEAO). The battle staff typically found on the smaller "workhorse" EC-135 is more restricted in space and limited to intelligence, operations, logistics, plans, communications, and radio maintenance people all permanently assigned to the 2nd Air borne Command and Control Squadron (2 ACCS).

Using the E-4B instead of the EC-135 as the platform for the airborne command post provides a

significant operational improvement. The E-4B has well over six times the deck space and five times the cubic volume as the EC-135. The increased space permits additional electronics and communications processing equipment and room for an expanded battle staff. The expanded battle staff includes additional manning in many of the existing functions plus a variety of new positions including an Engineering and Services (E&S) officer, missile launch, and reconnaissance officers.

Each time the "Looking Glass," utilizes an E-4B for a sortie, an E&S officer flies along as an integral part of the expanded battle staff. The E&S officer functions as the technical expert to the AEAO and the battle staff on damage evaluation and other unique engineering and services problems as a result of a hostile attack, accident or natural disaster. The primary responsibilities include determining the extent of damage from nuclear detonations, evaluating the remaining resources and capabilities at SAC interest locations, and recovery and restoration of airfields capable of supporting sustained SAC air operations. Additional responsibilities include using current weather information to predict radioactive fallout arrival/clear times and intensity levels. The E&S officer maintains the battle staff situation map indicating nuclear detonation impact locations and radioactive fallout patterns. The E&S officer also provides expertise on many of the typical engineering and services problems encountered on the headquarters and base-level command post battle staffs.

The E&S officer is the airborne battle staff focal point on residual airfield capabilities and radioactive points-of-interest called "hot spots." The position requires considerable training in the effects of nuclear detonations and radioactive fallout predictions before the individual is fully qualified" to fly on the airborne command post. In addition, the E&S officer must be technically competent in such areas as airfield pavement capabilities, utility systems, structural characteristics of facilities, messing, billeting, and mortuary facilities at various SAC interest locations. These skills are tested for proficiency each time in the form of an exercise scenario.

The first E&S officers to serve on the Airborne Command Post. (LEFT TO RIGHT) Capt Wise, Maj Bean, Capt Foltz and Capt Tyley.

Captain Jeffrey L. Tyley is a civil engineering management consultant in the maintenance division, directorate of Operations and Maintenance, Headquarters Strategic Air Command. He received his bachelor of science degree in civil engineering from North Dakota State University and his master's degree in industrial engineering from the University of Arkansas. He is a member of the Society of American Military Engineers.

Currently there are four positions (three engineers and a services officer) on the headquarters staff designated as flying officer positions used to augment the airborne command post. To be qualified, the individual must first pass a Class III flying physical, complete physiological training (altitude chamber) and possess the appropriate security clearance. Qualification permits wearing the new nonrated officer aircrew member wings and authorizes hazardous duty incentive pay. The wings become authorized for continuous wear after two years on flight status.

Brig Gen John E. Catlin, Jr., former deputy chief of staff, Engineering and Services, SAC, before his retirement pinned the new wings on the first Engineering and Services officers. Recipients were Maj Allan K. Bean, Captains Lawrence E. Foltz, and Timothy G. Wise, and myself.

This is an exceptional opportunity for young E&S officers to perform actual "hands-on" operational flying duties while assigned to the headquarters staff. The airborne battle staff operational capability has been enhanced because the E&S officer provides a realistic damage evaluation and radiation fallout prediction capability.

The long-range plans call for acquisition of additional E-4 aircraft to replace the EC-135 for full-time airborne command post operation. At that point in time, E&S officers will be permanently assigned to the 2 ACCS as full-time members of the airborne battle staff. Until then, the position will be filled by augmenting with officers from the headquarters staff, giving them our expertise whenever needed.

It's a tremendous opportunity for E&S officers to be part of this prestigious flying operation. Just think, we're probably up there right now.

Directorate of Engineering and Services

Current Emphasis

a brief commentary on significant developments

STORAGE OR DISPOSAL OF NON-DOD-OWNED HAZARDOUS OR TOXIC MATERIALS ON AF INSTALLATIONS—

IMC 81-4 to AFR 87-3 prohibits granting the use of AF facilities for the storage or disposal of non-DOD-owned hazardous or toxic materials as defined in P.L. 96-510 and Federal Standard 313A. Requests for exceptions to this policy must be sent to the HQ USAF Real Property Division (AF/LEER). Base real property officers have been provided additional details. (AF/LEER, Mr. Skidmore, AUTOVON 297-4033)

POLYCHLORINATED BIPHENYLS (PCB) CLEARANCE CERTIFICATES—

HQ USAF on Sept. 24 provided all MAJCOMs with a sample PCB clearance certificate, which must be executed and signed by the base commander or, if the base is inactive, by the chairperson of the command environmental protection committee. The certificate will be made a part of all future declarations of excess submitted to HQ USAF. (AF/LEER, Mr. Skidmore, AUTOVON 297-4033)

PASSIVE SOLAR

applications which are presently not listed in AFM 88-15, are to be considered experimental and unproven for our type and size facilities. Some of these "unique" passive applications are greenhouses, roof ponds, Thrombe walls, solar chimney, and earth tubes. Several of these applications, if proven cost-effective, will be considered for inclusion in one FY 83 and three FY 84 MCP projects. (AF/LEEE, Mr. Brown, AUTOVON 297-4240)

AFM 88-15—

HQ USAF/LEEES is currently revising AFM 88-15. The revisions are being accomplished by contract. Included in the contract are revising existing criteria, creating new criteria, and revising the format to agree with the Construction Specification Institute (CSI) indexing system. Once this nine-month task has been completed the criteria will be easily cross-referenced to construction specifications as well as contain accurate up-to-date guidance. (AF/LEEE, Mr. Brown, AUTOVON 297-4240)

AFR 85-1—

The revised AFR 85-1 is in the last stages of processing in preparation for publication. The proposed publications date is early 1982. The new and revised forms associated with the changes in the regulation will not be published until after regulation is published. (AFESC/DEMB, Maj Johns/SMSgt Redmiles, AUTOVON 970-6387/6391)

ENGINEERED PERFORMANCE STANDARDS (EPS) PROGRAM—

HQ AFESC/DEMG has revised the EPS program to increase the number of EPS utilization and assistance visits from 30 per year to over 50 scheduled in FY 82. Major commands are getting more involved and the revised program calls for more emphasis on BCE management within the program. (AFESC/DEMB, Maj Golondzinier, AUTOVON 970-6379)

CIVIL ENGINEERING MATERIAL ACQUISITION SYSTEM (CEMAS)—

Two working group meetings have been held at AFESC to develop the new CEMAS supply support system. Representatives from MAJCOM/DEM/LGS/LGC activities and HQ USAF, AFLMC, AFDSDC, and AFAFC attended the working group meetings. CEMAS envisions a minicomputer in civil engineering material control that will manage the supplies needed to support the work force. Plan calls for prototyping CEMAS in 1982 and implementation in the 1983-1985 time frame. (AFESC/DEMG, Maj Harvey, AUTOVON 970-6386)

AUDIOVISUAL RELEASE—

The following ISD programs are available for Prime BEEF home station training use:

52624 ST 35 I, "Hardback Tent Construction," covers material requirements and construction techniques for a 16x32 ft. tent frame as referenced in AFM 86-3, Vol I; 5300 ST 35 I, "Assembly of AM-2 Matting Patch," covers selecting an assembly area, assembling the components, and towing/positioning the matting patch. Both can be obtained through your local audiovisual service or from the Defense Audiovisual Agency, Norton AFB, Calif., 92409. (AFESC/DEOT, CMSgt Dees, AUTOVON 970-6135)

TOTAL MANPOWER REQUIREMENTS AND RESOURCES (TOMARR)—

Beware of those manpower authorizations in your command manpower data system coded "P"—in the second position of the TOMARR codes. The "P" is a signal to the manpower community that a position is not a wartime requirement and can be converted or contracted. "H" means Wartime Available (Peacetime Required Only). All engineering and services authorizations, military and civilian, should be committed to strategic withhold. CONUS sustaining or deployment TOMARR codes can be corrected manually. AFESC/DEOP, SMSgt Smith, AUTOVON 970-6146)

ENGINEERING & SERVICES INDIVIDUAL MOBILIZATION AUGMENTEES (IMAs)

are valuable reserve personnel resources of the major commands. They are authorized and assigned to positions required by contingency and wartime emergency plans. AFESC/DEO is the functional manager of the E&S IMA program and should be consulted for guidance and assistance. The new AFR 93-3 will contain guidelines for managing the E&S IMA programs. (AFESC/DEO, Capt Fravel, AUTOVON 970-6145)

THE FACILITY ENGINEER JOB ESTIMATING (FEJE)

system test at Tinker AFB, Okla., is successful. Planners are applying EPS to 86 per cent of the jobs they plan without an increase in planning time. Tinker planners think the automated method is superior to the manual method of applying EPS. Funds for implementation are being worked in the FY 84 POM. (AFESC/DEMG, Maj Golondzinier, AUTOVON 970-6379)

INSERVICE WORK PLAN AUTOMATION

is proceeding well at eight test bases. Program assists in the generation of the AF Form 919 through application of computer gathered historical data. All computer solutions can be overridden by the IWP programmer. Worldwide use slated for March 1982. (AFESC/DEMG, Maj Golondzinier, AUTOVON 970-6379)

MAINTENANCE OF BLIS (BASE LEVEL INQUIRY SYSTEM)

data element tables SETLF for civil engineering reports generation will be discontinued in September 1982. All BLIS programs should be rewritten in the Air Force On Line Data System (AFOLDS). (AFESC/DEMG, Maj Golondzinier, AUTOVON 970-6379)

AF FIRE LOSS EXPECTED TO RISE—

Beginning in 1982, the methods used to calculate fire damage and loss will be changed drastically. Presently, the fire loss figures are based on the **original** cost of the facility (and contents). The new method will base fire loss figures on **replacement** costs. We expect fire loss to increase substantially. (AFESC/DEF, SMSgt Warner, AUTOVON 970-6144)

WATER POLLUTION CONTROL—

Federal involvement in water pollution control is clearly declining. State environmental agencies have been encouraged to review their discharge standards and begin to formulate new approaches of pollution control. Engineers and planners throughout the Air Force should carefully monitor the progress of state water policy and seek an active role in the local review and comment process. (AFESC/DEVP, Capt Downey, AUTOVON 970-6182)

MEAL, READY TO EAT (MRE)

production on the first DOD contracts for 24 million meals has been completed with a second buy of 48 million meals scheduled. The Air Force will receive a small percentage of the MREs. The bulk will be issued to Army and Marine Corps as the replacement for the meal, combat, individual (MCI). Concerns over the possible infestation of menu bags during prolonged storage prompted research and development work to identify a more acceptable, reasonably priced menu container. The need for measures to assure long-term product safety for MREs in storage has been identified to commissary, medical and entomological personnel at Air Staff level. (AFESC/DEHF, Mrs. Gotshall, AUTOVON 970-6214)

by Lewis R. Shotton

Concern is frequently expressed by reviewers of Air Force proposals for new low-level training routes and military operating areas regarding the effect of jet noise on wildlife and farm animals. Occasionally the Air Force is asked to change an existing or proposed low-level route in order to reduce noise impacts on wildlife refuges, endangered species habitat, poultry farms, etc. Adequate review of this issue is important in responding to these requests, and in preparing environmental analysis documents.

Repeated exposure to loud noises can be an irritant for humans. However, we must be careful not to assume animal responses to noise are analagous to human responses. Most published studies regarding the effects of jet aircraft noise on wildlife and other animals deal with sonic booms (generated by supersonic flight). A review of the few reports dealing with subsonic, low altitude, jet aircraft overflights suggests that animals, unaccustomed to jet aircraft noise, generally respond in the same manner as they do to sonic booms. Responses range from a momentary pause or alteration of current behavioral activity to a startle reaction followed by running (or flight).

The apparent similarity in animal responses to jet flight less than 1,500 feet above ground level and sonic booms (usually generated at altitudes higher than 8,000 feet above ground level) is not surprising. In both instances, the noise is usually loud, sudden and of relatively short duration. (Keep in mind the purpose of low-level flying tactics is to surprise the opposing forces.) For comparative purposes, the noise level from an F-4 at 200' slant distance, operating at cruise power and 300 knots indicated airspeed is about 144 dB (c); whereas a sonic boom noise level from air combat maneuvering operations ranges from 111 to 116 dB(c). (Chavis 1981.)

On the other hand, differences in noise from low-level subsonic overflight and higher altitude supersonic overflight include the longer duration of noise from a low-level overflight, the greater probability that noise from low-level overflights will be accompanied by visual perception of the aircraft and the broad band frequency distribution for jet engine noise (about 200 - 20,000 Hz) versus the low frequency noise of sonic booms (with most of the sound energy between 15 - 50 Hz).

Wild animals appear to acclimate easily to low-level jet overflights. Fletcher (1977) recognizes this by pointing out that if aircraft engine noise was aversive to wild animals, areas around large airports would be devoid of wildlife. Actually, large airports often provide habitat for a wide diversity of wildlife species. At some Air Force bases and bombing / gunnery ranges, management of wildlife populations is a major aspect of extensive programs for multiple use of natural resources. In many instances, [illegible] of wild species, created [illegible] and airspace hazard to aircraft operations [illegible] this concession is supported [illegible] programs to [illegible] deer collison [illegible] Discouraging use of [illegible] by birds and other [illegible] Techniques involving [illegible] pyrotechnics are only temporarily effective.

Milligan (1980) indicates that a review of scientific studies and his own experience as a veterinarian and poultry scientist supports the following conclusions quoted below:

a. **Sound has no effect on hatching success of quail eggs.**
b. **Sonic booms do not affect embryonic mortality in quail.**
c. **The hatchability of chicken eggs is unaffected by sonic booms.**
d. **Sound has no effect on spermatogenesis in roosters, growth of chickens or hatchability of eggs.**
e. **Repeated sonic booms have no effect on hatchability of eggs of free-living wild birds.**
f. **Pressures sufficient to break eggs are approximately one order of magnitude greater than those that can be expected from sonic booms.**
g. **Poultry exposed to sonic booms experience a startle reaction and cease**

OUR BIGGEST FACILITY: THE AIRSPACE

Readiness, the theme of the **Quarterly**, *is a double-bladed sword: readiness as it pertains to facilities and equipment and readiness of personnel through proper training. Proper training includes low-level aircraft operations and our biggest training facility is the airspace above us. The requirement for low-level training routes exists to provide a realistic training environment to insure aircrews are capable of performing their assigned mission in the emergency war order (EWO). To support this continuing training effort new routes must be developed. The information provided in this article will better enable environmental planners to address problem areas in route development.* **Capt Geral L. Long, AFESC/DEVN**

activity for 20 - 30 seconds after each boom.

h. Starlings, skylarks, linnets, ravens and condors all display startle reactions to sonic booms.

i. Mallard, Tufted, and eider ducks show a startle reaction to sonic booms and feeding activities are briefly interrupted.

j. Raptorial and songbirds also show a startle reaction to sonic booms.

k. Brooding behavior of terns, chickens and domestic turkeys is affected by sonic booms, but there is no effect on the eastern wild turkey.

l. Sonic booms have no effect on pheasant egg production.

m. Egg production in domestic turkeys is unaffected by noise.

n. Poultry scientists are convinced that sonic booms have no effect on egg production.

jets pass at distances of 100 meters or less.

c. Large nestlings are alerted, but show no alarm when jets pass at distances greater than 300 meters.

d. Adults are usually alerted or alarmed by jets passing closer than 300 meters. At times adults ignore even the closest aircraft. On rare occasions adults flee when a jet approaches to within 300 meters.

e. Aircraft passing nesting sites at distances greater than 500 meters are ignored or casually watched by adults.

f. Adult behavior indicative of site abandonment was not observed. In no case was nestling death or eyrie abandonment implicated.

g. Nesting success and second-year site reoccupancy rates were high for all eyries.

LOW LEVEL ROUTE

Responses of wildlife and farm animals to low level military jet overflight.

In summary, [illegible] studies on a wide variety of [illegible] few, if any, obvious long-lasting physiological effects from exposure to sonic booms or their noise. Perhaps it can be stated with reasonable certainty that there will be a startle response. Birds' reactions to sonic booms are temporary, and all seem soon return to normal activity. Experimentally, food startle reactions can be provoked in geese, poultry but the birds quickly adapt and there are no deaths or drops in egg production.

A two-year study conducted by Ellis (1981), under cooperative agreement between the U.S. Fish and Wildlife Service and the Air Force, involved nearly 1,000 jet aircraft passes at 47 breeding sites of eight species of birds of prey (including the endangered Peregrine Falcon) to record responses to low-level jets and sonic booms. Ellis' conclusions regarding low-level jet passes are:

a. Small nestlings do not noticeably respond.

b. Large nestlings may cower or flee (within the nest area) when military jets pass at distances of 100 meters or less.

c. Large nestlings are alerted, but show no alarm when jets pass at distances greater than 300 meters.

d. Adults are usually alerted or alarmed by jets passing closer than 300 meters. At times adults ignore even the closest aircraft. On rare occasions adults flee when a jet approaches to within 300 meters.

e. Aircraft passing nesting sites at distances greater than 500 meters are ignored or casually watched by adults.

f. Adult behavior indicative of site abandonment was not observed. In no case was nestling death or eyrie abandonment implicated.

g. Nesting success and second-year site reoccupancy rates were high for all eyries.

[illegible] summarized [illegible] of sonic booms on wildlife [illegible] animals. Reported studies reached the following conclusions:

[illegible] Deer on Eglin AFB, Fla., show no apparent response to sonic booms.

[illegible] a group of young chimpanzees, the reactions of London Zoo animals to sonic booms are negligible. (The term negligible was not expanded upon.) Chimpanzees showed a "tendency toward fright."

c. Sonic booms with overpressures of about 1.25 lbs/sq ft caused a slight startle effect among reindeer confined in a one acre corral. Reactions were more noticeable when boom overpressure increased to about 4 lbs/sq ft; however, none of the lying or resting animals arose.

d. Rheas converged or flocked immediately following exposure to a chance sonic boom. They began to disperse within 10 minutes.

e. **Wild pheasants and quail egg production and hatching success were unaffected by simulated booms.**
f. **Sonic booms appear to have no effect upon fish.**
g. **The hatchability of chicken eggs, exposed to over 600 booms at White Sands Missile Range, N.M., was not affected.**
h. **Sooty tern eggs failed to hatch after chance exposure to sonic booms. Three very intense sonic booms (overpressures unrecorded) may have caused embryo damage due to egg abandonment or physical damage to uncovered eggs.**
i. **A sonic boom test conducted at Edwards AFB, Calif., revealed minimal responses from horses, cattle and sheep. Poultry responded by occasionally flying, running, crowding and cowering.**

repeated, loud noises can be an irritant.

j. **Cattle responded to sonic booms by briefly stopping or altering their current behavioral activity. Milk yield was not affected. Semen quality or quantity was not changed. Calves were born at term after sonic boom exposure during the first month of pregnancy.**
k. **Sheep responded to sonic booms by briefly stopping or altering their current behavioral activity. Running together was observed but there was no panic or injury.**
l. **Pigs stopped their current activity and remained quiet for a few seconds when exposed to a sonic boom.**
m. **Horses (especially purebreds) have been reported to jump and/or gallop in response to a sonic boom.**
n. **Repeated exposure to sonic booms caused no signs of disturbance or deleterious effects on reproduction related activity in mink.**

Long-term exposure effects and physiological responses remain to be studied; however, there are many examples of wildlife populations including endangered species that live in apparent harmony with long-term exposure to low-level jet overflights. The endangered Brown Pelican and numerous other wildlife species utilize a mangrove swamp habitat on either side of the approach end of the main runway at MacDill AFB, Fla. Fighter jet aircraft routinely pass about 300 to 800 feet above feeding or roosting Brown Pelicans. Pelicans and other wild animals show no behavioral response to the overflights. Animals on the Nellis and Luke Air Force ranges have been exposed to low-level jet aircraft noise for over 25 years with no apparent effects. U.S. Fish and Wildlife Service records show the age structure and population count of bighorn sheep on the Nellis range have not significantly changed. Over the past two decades the "wild" horse population on the Nellis range has grown from approximately 200 to an estimated 6,000 horses. On the Luke range, falcons nest under low-level corridors where jets frequently pass very close to the surface (Ellis, 1981). Cattle grazing in close proximity to target complexes on the Avon Park Air Force Range show no behavioral response while jet aircraft make low-level target passes.

Reported scientific observations and studies regarding the effect of low-level jet overflight on animals are not conclusive. There may be circumstances when it is prudent to avoid low-level overflight of wildlife or other animals. A confined farm animal may injure itself or other animals if startled. However, the preponderance of information on this subject indicates that wildlife and farm animals do not suffer major or long-term adverse effects from low-level military jet overflight.

REFERENCES

1. Chavis, A. Dec. 7, 1981, Personal communications.
2. Cottereau, P.H. 1978. Effects of Sonic Boom from Aircraft on Wildlife and Animal Husbandry. In: J.L. Fletcher and R.G. Busnel (eds). **Effects of Noise on Wildlife,** *pp. 63-79.*
3. Ellis, D. H. 1981. "Responses of Raptorial Birds to Low Level Military Jets and Sonic Booms," contract study U.S. Fish and Wildlife Service and U.S. Air Force. HQ TAC, Langley AFB, Va., 59 pp.
4. Fisher, J. 1978. "Birds and Airplanes Don't Mix," **International Wildlife.** *8:7-19, Mar 78.*
5. Fletcher, J.L. 1977. "Effects of Noise on Wildlife and Other Animals: Review of Research Since 1971," EPA contract WA-7-1673-J, U.S. Environmental Protection Agency, Washington, D.C., 24 pp.
6. Milligan, J.E. 1980. "Opinion of USAF OEHL Staff Veterinarian," USAF OEHL, Brooks Air Force Base, Tex., 5 pp.

E&S

Lewis R. Shotton *is natural resources manager for the Tactical Air Command, Langley AFB, Va. Prior to moving to the headquarters, he was Langley AFB environmental coordinator. He is a 1967 graduate of Virginia Military Institute with a bachelor of arts degree in biology. He holds a master of arts degree in marine science from the University of Virginia. He served in Vietnam as an infantry lieutenant.*

tecnotes

CALCULATOR SOFTWARE — For those using programmable calculators HP 67/97 or TI 59, many engineering software packages can be bought from CALPRO, 3119 Waterlick Road, Lynchburg, Va., 24502; or McClintock Corp., 7000 S.W. 62nd Ave., Box 430734, Miami, Fla., 33143. Write for catalogs. (AFESC/DEMG, Maj Golondzinier, AUTOVON 970-6379)

RECALL — Some commercial and residential smoke detectors made by Chloride Protector Division, Chloride, Inc., Hingham, Mass., are being recalled. Some were sold in Europe through the Army-Air Force Exchange Service until April, 1981. Reason for the recall is a potentially defective microchip which may prevent the alarm from sounding. Units recalled are: Chloride Protector Models 3077, 3078 or 3079; Archer (Radio Shack) Model No. 275453; Masterguard MGB 360; Vanguard 817; and Protecter Systems P365.

THE RANGE PLANNING PROGRAM is ready for technical transfer to the field. It consists of a five-step planning process that shows a range planner how to assemble a staff, formulate range objectives, list and evaluate alternatives, select the preferred option, and develop a range plan for implementation. A developed computer analysis shows degrees of risk for various planning options which will be of value to the range planner who must assess safety factors, operational needs, environmental impacts, public response and implementation factors. (AFESC/RDVA, Maj Thompson, AUTOVON 970-2907)

LASER REMOTE SENSING is a powerful new technique for the rapid detection and measurement of toxic gases at distances up to several miles under development at the Massachusetts Institute of Technology Lincoln Laboratory. A major milestone was recently achieved when pollutants in the exhaust of an A-10 aircraft were successfully measured from over a mile and half away. Future applications include tracking of toxic vapor releases and detection of chemical warfare agents. (AFESC/RDVS, Capt Clewell, AUTOVON 970-4234)

AIRFIELD PAVEMENT RECYCLING - Pavement recycling at Lajes AB, Azores has stopped for calendar year 1981. Sixty-one thousand tons of recycled hot mix asphalt was placed. Work is scheduled to restart in April 1982. This is one of the early USAF efforts to recover and reuse airfield pavement materials. (AFESC/RDCF, Lt McDonald, AUTOVON 970-6271)

IMPROVED FIRE PROXIMITY SUITS - A new Kevlar 8-oz fabric fire proximity suit is being introduced into the DOD inventory. This suit will have a minimum 5-year durable life span. (AFESC/RDCS, Mr. Walker, AUTOVON 970-6284)

EQUIPMENT HARDENING - Analyses of weapons effects and vulnerability data for equipment and personnel show that survivability can be improved significantly with some easily implemented measures. For example, wearing a helmet and flak vest will increase an individual's probability of surviving the explosion of a large bomblet at 20 feet from 3 per cent to 21 per cent. Materials such as Kevlar, Lexan, foam-filled tires and judicious use of steelplate can increase survivability of equipment substantially. (AFESC/RDCR, Mr. Alexander, AUTOVON 970-6326)

DUAL-DRUM VIBRATORY ROLLERS - Testing at Tyndall AFB, Fla., has shown that a 30 per cent saving in compaction time on RRR tasks can be expected by using dual drums instead of a single drum on vibratory rollers. Future procurement of self-propelled vibratory rollers will specify dual drums. (AFESC/RDCR, Maj Carter, AUTOVON 970-6313)

RRR SUPPLEMENTAL EQUIPMENT SETS - The first six of these sets are included in the FY 82 equipment buy program. Each set will include 7-each, 8 cubic-yard dump trucks and 4 cubic-yard scoop loaders; and 3-each, wheeled hydraulic excavators and self-propelled vibratory rollers. (AFESC/RDCR, Maj Carter, AUTOVON 970-6313)

CESMET tips

The Air Force Civil Engineering and Services Management Evaluation Team (CESMET) reviews, evaluates and assists base civil engineering and services functional areas in accomplishing their mission in the most efficient and effective manner. This department is designed to pass along new ways to do the job better.

We present certificates of outstanding achievement to base personnel who are doing absolutely "top notch" work. Here is a list of the latest recipients.

Bergstrom AFB—	Personnel	Exceptional Base Appearance
Bergstrom AFB—	Mr Ken Toney	Vehicle Maintenance Superintendent
Edwards AFB—	SSgt Clinton Rogers	Dormitory Manager
Edwards AFB—	Structural Maintenance and Repair Team	Outstanding Team Efforts
Edwards AFB—	Pavements, Equipment, Grounds	These three sections were recognized for their outstanding contributions to improve the base appearance

CIVIL ENGINEERING

Are foremen getting their work packages early enough to allow ample time to determine availability of materials, equipment and vehicles?

At some bases foremen get work packages as little as two days prior to the weekly scheduling meeting. This drastically reduces the time foremen have to make necessary plans.

Schedulers at Edwards AFB find it more feasible to pass work packages to shop supervisors on Friday. The foremen then have a minimum of four work days to check the work packages prior to the scheduling meeting on Thursday. This practice enhances the scheduling process and is a great aid in meeting the BCE's commitment to customers.

CONTRACTING

During several of our recent base visits we have noted that the current or planned use of indefinite delivery (open-end) A&E contracts has increased. CESMET heartily endorses and frequently recommends this approach to increasing the BCE's capability in the design area.

"Open end" A&E contracts appear to be the most practical method of working base design programs in view of engineer vacancies and the increasing workload we see at the base level.

Here are some ideas to consider:

HQ SAC DEE/LGC developed an excellent 'how to' package for open end contract efforts.

An individual base may have several contracts, e.g., one for structural work, one for electrical work, etc.

Maximum award fee levels may be increased from time to time. Waivers may be requested, through MAJCOMs to AF/RDC, for an additional option year if unique situations exist, e.g., a base in a remote region of the CONUS, etc.

Keep contracting "on board." They're working the mission with you!

MATERIAL CONTROL

Do you have job orders and work orders with completed bills of materials in your holding area that have **already** been completed or canceled?

"Can't happen in my holding area!" you say? If you are not reconciling your completed work orders and job orders periodically with production control you are in for a surprise!

AFR 85-1 requires you to review each completed bill of materials monthly.

We have found that those bases which reconcile work orders and job orders monthly do not have the problem. How is your holding area? Are you holding materials that are no longer required?

BUDGET

HQ MAC and HQ SAC recently held week-long civil engineering financial management training seminars which offered a broad spectrum of subjects pertinent to expanding the financial manager's job knowledge.

We view this as an excellent approach for providing needed training for BCE financial managers. An added benefit is the opportunity to cross-feed innovative ideas and share common concerns and problems.

You may want to follow the MAC approach and bring the BCE in at the same time, holding several joint workshop sessions during the week.

SERVICES

During our base visits we observe many innovative ideas. Here are synopses of two that you may want to use.

- Recurring problems in the dormitories include lost key replacement and weekend calls from those who have locked themselves out of their rooms. One base uses a built in "simplex" combination lock to solve these problems. The dormitory manager can easily change combinations with his master key and the residents don't have keys to lose. Bring this one up at your next Quarters Improvement Committee meeting.
- More than 300 uniform items **must** be stocked in clothing sales at all times. Several bases are using small yellow markers to highlight "MUST" items, allowing walk-through spot checks by clothing sales employees and services officials who can quickly check stockage on shelves.

Metallic Conduits

by Norman L. Fowler
Electrical Engineer, AFESC/DEMC (CEMIRT)

Many engineers and electricians assume that the only purpose of an electrical conduit is to provide mechanical protection for the phase conductors and do not realize that it is the primary return path for current under ground fault conditions. Studies show that 90-100 per cent of the current in a faulted conductor returns over the conduit itself.

For this reason, the conduit must be treated as a conductor and all joints and couplings must be clean and tight. The importance of these precautions was illustrated by a series of tests where high current returning over the conduit produced sparks from about half the couplings. A "blow torch" stream of sparks was emitted from one of the couplings burning out many of the threads. The conduit run had been installed by a crew regularly engaged in this type of work and they had given assurance that all the joints had been pulled up to a little more than normal tightness. In separate but similar tests, sparking occurred even though the couplings were provided with bonding jumpers around the coupling assembly. This further emphasizes the importance of clean, tight couplings in a conduit system.

Most seemingly sound methods of relieving the conduit of this current flow, such as connecting it to nearby building structural members or installing an external grounding conductor, are ineffective. This is because the higher reactance associated with these remote paths influences the current to seek the conduit path for return flow. Furthermore, the omission of the conduit could lead to large induced voltages in nearby metallic structures and result in dangerous shock hazards or unwanted circulating currents. Only the use of an **internal** grounding conductor or nonmagnetic (aluminum) conduit is effective. Even these methods will reduce the current only fractionally with use of aluminum conduit being the better of the two.

Another effect of this conduit reactance is that it decreases the level of ground current in proportion of the length of conduit. This is important since reduction of ground fault current to a level below the instantaneous "trip" of the protecting molded-case circuit breaker can result in an abnormally long breaker clearing time and correspondingly greater damage at the fault point. A maximum conduit length is thus estalished if the ground current is not to be reduced to a level below the instantaneous trip setting. This length varies according to the size of the conduit and cable and can be figured out from the tables in Chap. 4 of the publication **Switchgear and Control Handbook** by Smeaton. It is interesting to note that the permissible length of steel conduit with the internal grounding conductor is 1.7 times that of the same feeder without an internal ground and that aluminum conduit can be installed in even greater lengths and still be "safe." In summary, it is evident that under abnormal conditions, the metallic conduit surrounding electrical conductors becomes part of the electrical circuit and must be treated as such. The following conclusions should be observed in any design and installation of metal conduit:

- **Because ground fault current will return over the conduit, all conduit joints and couplings must be clean and tight.**
- **The only effective means of reducing this current is the installation of an internal grounding conductor or the use of aluminum conduit.**
- **The low ground fault impedance of feeders in aluminum conduits could provide a decided advantage over steel conduit under certain conditions.**
- **Care should be taken not to install lengths of conduits greater than the maximum safe length.**

REFERENCES:

1. Kaufman, R.H., "Some Fundamentals of Equipment-Grounding Circuit Design" AIEE Transactions 73, Pt II, 227-32 (1954) Nov.

2. Gienger, J.A., Davidson, O.C. and Brendel, R.W., "Determination of Ground-Fault Current on Common A-C Grounded Neutral Systems in Standard Steel or Aluminum Conduit," AIEE Transactions 79, Pt II, 84-90 (1960) May.

3. Smeaton, R.W., Switchgear and Control Handbook, McGraw-Hill, 1977.

Wartime survivable E&S command and control

ESRC showing status charts, secure telephone booth and administrative arrangement.

by Lt Colonel
Richard J. Bergholz

On Oct. 18, 1979, General John W. Pauly, commander in chief, U.S. Air Forces in Europe (USAFE) opened the concrete shell of the new HQ USAFE operation support center (OSC). This signaled the completion of the first phase of the project on which design had started two and one-half years before. It also signaled the beginning of the phase II contract calling for interior finishing of the building. On Mar. 29, 1980, the OSC was officially placed into operation, permitting USAFE engineering and services force development division, of the European air combat operations staff (USAFE EUROPS) to relocate and establish permanent residence in its new OSC office, called the USAFE Engineering and Services Readiness Center (ESRC). The activation of the USAFE EUROPS ESRC in an operations support center marks a USAFE milestone in establishing the engineering and services profession as an integral part of operational planning during crisis management.

It is a hardened USAFE operation support center, combining critical functional organizations vital to support U.S. Air Forces assigned or earmarked for NATO. The center has been under consideration and planning since 1973. However, due to funding limitations, design of the facility could not begin until April 17, 1977.

The structural design of the facility permits withstanding both general purpose and nuclear weapons. The structure is totally shielded by 1/8-inch welded steel plate to withstand the effects of electro-magnetic pulse. There are redundant shock-isolated utility systems to increase system reliability. For example, the facility contains:

- **200 per cent, fully-automatic backup power,**
- **two 90-meter water wells,**

• two complete biological/chemical air filtration systems, and

• decontamination cells and systems for a processing capacity of 20 persons per hour.

The 25,000 square feet, $7 million facility is designed to house between 160 and 182 personnel for seven days.

Early in the planning stages the USAFE director for Engineering and Services recognized the importance of having an engineering and services center included in, and made a part of, the immediate operational combat support community. As a result of his initiatives 400 square feet of critical floor space was set aside to accommodate civil engineering and services personnel, a secure voice telephone booth, a visual information processor, readiness display boards, closed circuit television, and related administrative equipment.

The center directly supports the USAFE battle staff and adjacent command center operations, responding to requirements identified by the deputy chief of staff for Engineering and Services. The USAFE EUROPS ESRC functions as the focal point for continuity of combat-support related engineering and services operations, and for maintaining operational readiness of critical facilities and services for USAFE airfields. More specifically, the ESRC is responsible for:

• Collecting operational information and instructions from battle staff support centers and disseminating these to the USAFE base civil engineers.

• Maintaining communications with USAFE base civil engineers to collect and maintain status of force beddown, base utility operation, facility damage recovery, base denial operations and aircraft/structural crash-rescue fire suppression operations.

• Coordinating and combining USAFE-wide base civil engineering activities and requirements.

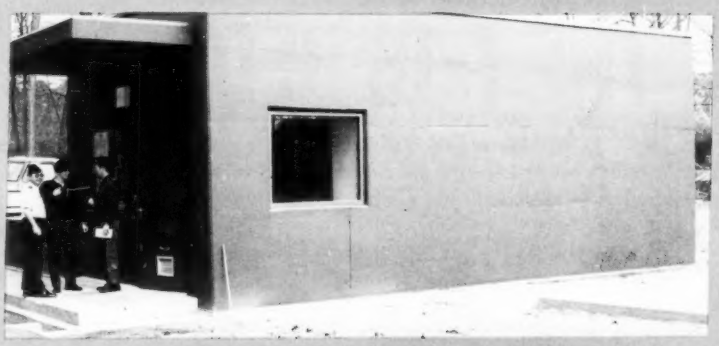
• Tasking USAFE base civil engineers for critical vehicles, equipment, and personnel intheatre supporting USAFE civil engineering emergency requirements.

• Coordinating and controlling with the U.S. Army, Europe (USAREUR), engineering unit deployments to air bases to assist in construction or reconstruction of facilities.

• Coordinating with USCINCEUR, HQ USAF, Air Force Engineering and Services Center, and the Military Airlift Command on the movement of forces and equipment from continental United States to USAFE bases.

To assist in the management of massive amounts of data, the ESRC has a dedicated computer terminal with direct access to the joint operation planning systems data bases and the civil engineering support plan generator. Information collected by telephone or from automated computer products can be summarized and displayed on status charts. Information on these boards can be transmitted via closed circuit television to television monitors in the commander's cab and the battle staff area to aid in the decision process.

For the first time ESRC facilities and management procedures provide the USAFE deputy chief of staff/Engineering and Services a means for automated, as well as manual correlation of inputs to support engineering requirements. This enhances the quality and timeliness of direct support to tactical commanders and USAFE decision makers.



Exterior view of OSC showing general elevation in relationship to ground level.

In summary, the engineering and services readiness center represents a solidification of concepts which have evolved because of an urgent need for an engineering and services command and control facility, integral to operations support planning activities, to support HQ USAFE's wartime/contingency missions. The activation of the ESRC as part of the operation support center will add immeasurably to credible civil engineering and services readiness. E&S

Lieutenant Colonel Richard J. Bergholz *is chief of the Force Development Division, European air combat operations staff (EUROPS), U.S. Air Forces in Europe. He holds industrial engineering degrees at the baccalaureate and master's levels, earned respectively, at the University of Illinois and Purdue University. He has completed Air War College by seminar, Air Command and Staff College by correspondence, and Squadron Officer's School in residence. He is an active member of the Kaiserslautern post of the Society of American Military Engineers*

THE F-16 BEDDOWN AT HAHN

by Charles W. Bentson

Facilities readiness frequently involves updating of facilities to accommodate new weapons systems.

The F-16 deployment to Hahn AB, Germany required construction and modification of maintenance facilities as part of a reevaluation of the base's capability to support the new high performance fighter. A FY 80 MCP line item for $1.8 million was established to support the beddown, including highly specialized F-16 facilities support.

The hydrazine servicing facility, known as the emergency power unit (EPU) shop, was the most unusual of the new requirements. The F-16 carries a tank containing a mixture of 70 per cent hydrazine-30 per cent water to drive an emergency power turbine. Because the F-16 is a "fly by wire" aircraft and carries no storage battery, emergency electrical power developed with the hydrazine EPU turbine is critical in case of failure of the F-100 jet engine or momentary failure of the main engine-driven electric and hydraulic power generators. The hydrazine-water mixture is used as a "mono-fuel" requiring no oxidizer and reacts when expanded through a catalyst to drive the EPU.

Hydrazine vapor is slightly heavier than air. So, good ventilation of the work space is important. The EPU shop was designed to provide a well-ventilated space for tank servicing and a room for storage of bulk tanks. Rooms are also provided where the personnel can change into work clothing before shifts, have a shower and after work remove any traces of hydrazine before changing back into street clothes. A holding tank is provided into which spilled hydrazine can be drained and neutralized before proper disposal.

F-100 Engine

Maintenance of the F-16's F-100 engine required extensive modification to the engine inspection and repair shop. This engine contains numerous time-rated components that must be replaced when their time expires. Since they have different hour-life ratings, a computer terminal is required to shift through the masses of information to determine which parts must be

replaced and when. Thus, the engine is replaced bit by bit, avoiding the "all at once" overhauls in a depot. Besides constructing more office space for the computer terminal and records, two bridge cranes, each with two hoists with 4.6 meter hook height, were provided to facilitate teardown of two engines at the same time. Another factor in F-100 engine maintenance is the large amount of space required for storage of jigs, handling aids, and test equipment. To provide room for such equipment and more space to maneuver the engine trailers, a five-meter addition was added to the 18-meter wide building. One of the requirements for the hoists was a five-meter hook height to permit lifting an engine in vertical position. The building eave height was not sufficient to allow the five-meter clearance for the bridge crane, but two of the old monorails were remounted in another part of the shop to provide the necessary five-meter hook height.

Hush House

Engine testing required a new test stand

ABOVE: Hush house foundation construction showing exhaust pipe support.
RIGHT: Engine inspection and repair shop being prepared for addition of lean-to.

because the existing water cooled test stand was not adequate for the powerful engine. After considering new water cooled and air cooled test stands, it was finally decided that a "hush house" was the only practical solution. The hush house takes the entire aircraft for an operational engine test, and is air cooled, avoiding the nuisance of water cooled test stands. The hush house was part of a "central buy," but the price did not include the foundation! The foundation is a very complicated reinforced concrete structure with very close tolerances for mounting bolts, and there was much concern as to whether a separate building contractor would satisfy the exacting requirements. The frame construction proceeded in a reasonably satisfactory manner, but it would have been highly desirable for a single contractor to have done the entire job.

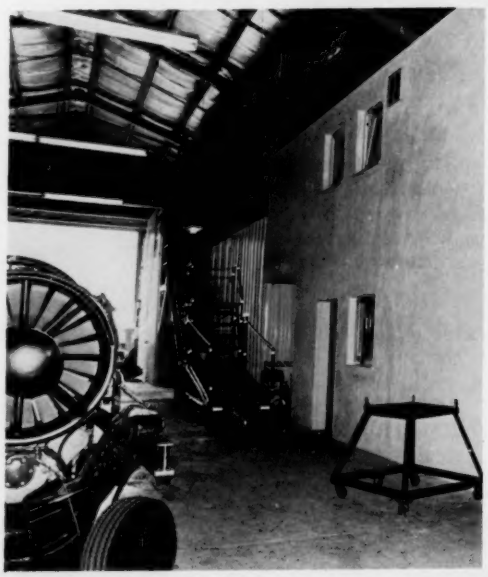
Avionics

The avionics shop was modified to accommodate the seven AIS (avionics intermediate shop) units' seven 4,000-pound, computerized test stations that require close climatic control and dust-free conditions. Previously, roof mounted exhaust fans had sufficed during the cool Hahn summers. For floor covering, an industrial carpeting was selected to provide optimum electrical isolation, acoustic control, operational comfort, and cleanliness. There was much conjecture as to whether the heavy AIS units could be moved using their air-cushion mobility provisions, but with plastic sheeting laid over the carpet the large units slid smoothly into place.

Simulator

The flight simulation facility was the biggest construction effort and most expensive project required for the beddown. The F-16 simulator requires complete environmental control and a specially designed building. The $1.8 million project, also in the FY 80 MCP, was designed from an Air Force definitive concept and is intended to be a standard design capable of housing future flight simulators.

The design and construction effort required nearly three years from the time the first design instruction was issued until the first beneficial occupancy date (BOD). At first glance this does



not seem a very good track record for an urgent project. Although a late starter in the FY 80 MCP, contract could not be awarded until FY 81 funds were available due to shortfalls in the FY 80 MCP, but in the meantime when FY 80 funds were expected "momentarily," the designs were held "frozen." Finally, the pressure to make changes mounted to irresistable levels and several of the designs went back to the drawing board for changes. The host nation construction agency (StBA) cooperated to the fullest, and completed the design for a $150,000 addition to the engine I&R shop before they received the paperwork requesting it. Exceptional cooperation was later demonstrated when the StBA modified contract documents to reduce construction times to meet our operational commitments after the projects had gone to bidding.

Delays in obtaining criteria played a major part in turning a reasonable construction period into a rush job. Design of the hush house foundation could not start until July 1980, 20 months after the first design instruction was written. One year after start of design the foundation was complete; ready for the structure to be erected! Design of the avionics shop started a year after the design instruction was issued due to delays in obtaining criteria and subsequent changes.

The construction agency, the Army Corps of Engineers, European Division, Frankfurt demonstrated responsiveness and flexibility in coping with the problems encountered. As the sole U.S. agency responsible for dealing with the host nation to administer MCP construction projects, their familiarity with host nation construction agency procedures and their abilities to cut corners proved invaluable in completing the project in time for the beddown. E&S

Charles W. Bentson *is a project manager in the Directorate of Engineering and Construction, Headquarters, U.S. Air Forces in Europe at Ramstein AB, Germany. He earned a bachelor of science degree in mechanical engineering at the University of Wisconsin in 1950 and is registered as a professional engineer in Vermont. He has also served as mechanical engineer in Air Force Systems Command, Naval Facilities Engineering Command, and the European Communications Area of the Air Force Communications Command.*

National Guard constructing BAK-14.

by Hartly Hansen

The new F-16 Fighting Falcon, one of the world's most advanced weapon systems, is operating safely at its CONUS main operating base thanks to a combined effort by active and reserve forces, military and civilian personnel, and a concerted effort to achieve necessary modifications to the runway arresting barrier system on time.

In January 1979, Hill AFB, Utah, became the location for the first wing of the new F-16 when the 388th Tactical Fighter Wing began receiving their new aircraft. Although extensive aircraft testing had been accomplished prior to this conversion, some deficiencies in supporting facilities were noted as the conversion took place. Although these deficiencies were minor and easily corrected, a major problem with the aircraft arresting system became highly visible.

The Cause

During this time F-16 operations included utilization of the full complement of external stores, including a center line fuel tank. The additional weight and reduced ground clearance were factors that generated an incompatibility with the existing above-ground BAK-12 aircraft arresting system.

F-16+BAK12=BAK14

Cable-slap damage was sustained by the center line tank and the aircraft speed brake.

Efforts to maintain a fixed-cable position (use of tie-down and continued tensioning) were hampered by other base mission traffic. Heavy cargo aircraft, which use the runway, including the C-130, C-141 and KC-135, caused a continual problem in maintaining the tension and position of the cable. By October, 1980 it was evident that the F-16 was incompatible with the BAK-12 arresting system. Six aircraft had sustained damage due to cable slap.

Engineering personnel from both affected headquarters, Tactical Air Command and Air Force Logistics Command, agreed that a flush-mounted cable would be required to provide safe aircraft operations. It was recommended that Hill, MacDill and Nellis Air Force Bases (F-16 bases) modify their BAK-12 systems to a BAK-14 underground configuration. Since the 388th TFW was nearing its full complement of F-16s and would have the most pressing need, Hill AFB was selected for the initial installation.

The 2849th Civil Engineering Squadron served as host for this program, and initiated programming, planning and engineering action during mid-October, 1980. Due to the lack of in-house expertise in BAK-14 design and construction, contacts were made with both active and reserve Air Force military units to attain their help in critical areas. The base pavements engineer was assigned as the project coordinator and was tasked with the development of an installation plan to provide an operational BAK-14 system by the end of December, 1980.

The Plan

A pre-project meeting was called in November at Hill AFB. Attending were representatives from AFLC, AFLC's Ogden Air Logistic Center, its 2849th CES, the 119th Fighter Interceptor Group (ANG) Fargo, N.D., the 200th Civil Engineering Squadron (HR) Ohio, and local impacted users. The 119th FIG, having recently completed a similar project at Hector airport near Fargo, presented a slide overview of their project and provided a detailed printed outline of materials and equipment that would be needed for the project at Hill AFB. A step-by-step construction schedule was established and work assignments made.

Civilian and military personnel from the 2849th CES were assigned to provide design, power production, electrical, masonry and pavements support. The 119th FIG was scheduled to install the hardware with the 200th CES to wire and provide final power and control checkout. TAC personnel were to obtain funding and the BAK-14 kits.

The Weather

The execution of this plan had major constraints: winter weather, the need to retain flying mission support, the availability of resources to provide for rapid installation, and the availability of the BAK-14 hardware. The few BAK-14 hardware kits were previously allocated to other locations, and reallocation was necessary to satisfy the urgent Hill AFB requirements.

The overdue winter weather was a threat to each phase of construction. Freezing temperatures could complicate placement and testing of the pendant raising equipment. Ice could prevent the installation of the cable in ducts under the runway, as well as the installation of one-and-a-half miles of control cable to the control tower.

Other Missions

Maintaining the flying missions during the construction period required the establishment of a displaced runway threshold. This permitted aircraft to land further down the runway and provided a margin of safety for construction personnel. All work-around procedures for continuing flying operations were developed by base operations in conjunction with major users of the single runway. One of the more difficult of these problems was the length of runway required for takeoff of the KC-135 refueling tanker assigned to the 151st Air Refueling Group. The runway could not be down for any extended period which might jeopardize this mission. As a result of all this, construction crews were continually concerned with the overflights and time constraints.

In spite of all the anticipated complications, project approval was issued in the last week of October, which signalled the beginning of the planning, and the demonstration of a composite effort to meet the December operational deadline.

Engineering design was phased, using previous project plans, to permit concurrent ordering of materials. Contract support was solicited through the office of contracting and manufacturing to obtain a contract to saw-cut and excavate the existing concrete section of the BAK-12 barrier. The acquisition of BAK-14 supporting materials was assigned to 2849th CES personnel using the government - operated civil engineering supply store system. Headquarters TAC and AFLC ac-

quired the BAK-14 hardware kit and arranged for shipment to Hill. Planning and coordination actions were completed by Nov. 28, and construction was scheduled for Nov. 29. Continual follow-up with all support groups and suppliers had been and would continue to be stringently maintained throughout construction.

Getting the Job Done

By close of business Nov. 28, the 2849th CES had completed relocation of the runway threshold to permit continued use of the runway, the demolition contract had been awarded and the contractor had completed pavement removal at the BAK-12 location. The hardware installation and pavement replacement were completed by the 119th CEF on Dec. 6. The 200th CES (HR), working in conjunction with the 2849th CES, completed the duct work, wiring, and control panel installation on Dec. 18. Removal of the displaced threshold and construction cleanup were complete by Dec. 22, and the pilots and ground crews of the 388th TFW were presented with a Christmas present of a new BAK-14 arresting system.

The completion of this project was another successful demonstration of the "can do" attitude of Air Force personnel all working together—active forces, Air Force Reserve, Air National Guard and Air Force civilian personnel.

Hartly Hansen *is airfield pavements engineer at Hill AFB, Utah. He earned his bachelor's degree in geology from the University of Utah. He has 20 years experience in pavements with the state of Utah, Federal Aviation Administration, and the Air Force.*

TOP: Soil being placed and compacted around 1/5 scale test model of the horizontal shelter. BOTTOM: Residue of explosion from inside the shelter.

THE BIG BLOW OUT

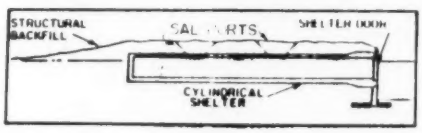
by Major Fred L. Hallberg

The time - 0955 hrs, Feb. 13, 1981, at a test location on the Nevada test site, Mercury, Nev. Five minutes are left in the countdown before the firing of 6,600 kg (14,500 lbs) of explosive in the largest dynamic airblast simulator ever constructed in the United States and possibly in the world. The countdown has thus far gone without a hitch or a hold. The test conductor and instrumentation personnel are busily responding to checklists and making last minute adjustments to the complicated signal conditioning and recording systems which will record the 715 different channels of data expected from the test.

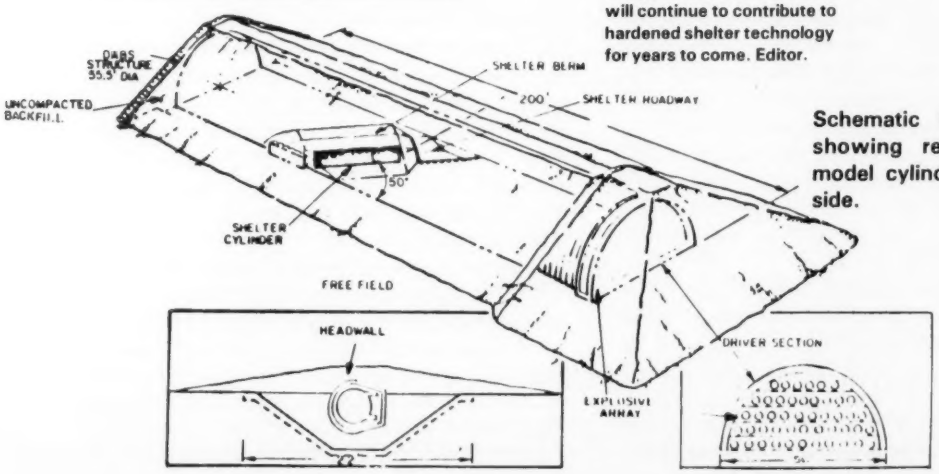
Purpose

The purpose of the test, run by the Civil Engineering Research Division of the Air Force Weapons Laboratory (AFWL), Kirtland AFB, N.M., is to determine the survivability and corresponding response of a 1/5 scale model of a verifiable horizontal shelter for the M-X strategic missile. The test article is 1.13 meters (3', 8-3/8") in outside diameter and 10.5 m (34', 4-3/8") long and weighs approximately 37.7 kgs (16 tons). This model structure is buried in soil with 300 mm (1') of cover. It is located inside a disposable dynamic airblast simulator (DABS) which is a metal arch-type structure, similar to the metal liners used in the aircraft shelters in Europe, 17 m (56') in diameter and 60 m (200') long. The purpose of the DABS is to create a simulated blast and shock environment of a nuclear weapon. The environment generated at the test article will be 3 MPa (435 psi) overpressure with a scaled-simulated yield of 3 megatons.

AFWL is responsible to the Ballistic Missile Office (BMO) for the test. Structural engineers and scientists did the computer design work



While the basing mode of the M-X missile system is undergoing change, this test of a scale model of the horizontal shelter stands as an epoch. Data from this test will continue to contribute to hardened shelter technology for years to come. Editor.



Schematic view of the DABS showing relationships of test model cylinder and explosive inside.

and ran the structural response models through various computer design codes to see what the theoretical responses would be based upon the predicted environment. The test article design was selected and given to the contractor, the University of New Mexico, which operates the AFWL Civil Engineering Research Facility (CERF). This is a government-owned, contractor-operated facility which does research work for AFWL, the Air Force Engineering & Services Center and other government agencies. Engineers from the AFWL monitored and controlled the construction of the test article. Of primary importance was the placement of

ABOVE: 6,600kg of explosives being secured to the driver wall.
RIGHT: Inside view of instrumented horizontal shelter test model with instrumentation cable and high speed camera.

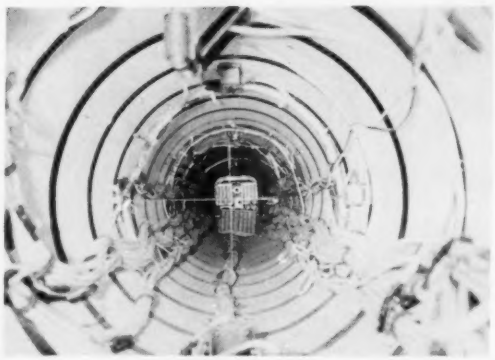
mounting hardware and plates for the various types of sensors or gauges (better known in the field as transducers) which are used to measure reaction/responses in the structure during the test. Some of the instrumentation used are strain, velocity, acceleration, displacement, and structure-medium interaction (SMI) gauges.

After the test article was fabricated, which took 60 days, instrumentation technicans assigned to the AFWL Civil Engineering Research Division installed and hooked up the internal structure gauges.

While the test article was being constructed and instrumented, other AFWL engineers were engaged in extensive computer analysis in developing the simulated nuclear environment design which would expose the structure to the pressure, impulse and time constraints of a given nuclear yield and attack scenario. (This is a very time consuming process which involves many theoretical iterations.) Once the type and quantity of high explosive is agreed upon (based on possibly several small calibration tests), the timing design, explosive pattern, etc. is drawn up and given to the field crews for installation.

While the test article was being constructed at Kirtland, the huge airblast simulator was being constructed at the Nevada test site (NTS) by the NTS support contractor, Reynolds Electrical & Engineering Co., Inc. (REECO). A civil engineer from the Ballistic Missile Office, Norton AFB, Calif., was the site construction manager supervising the construction and erection of the simulator.

This test was completed through much coordination and effort with and by numerous agencies such as BMO, AFWL, REECO, Holmes & Narver Engineering, Boeing Aerospace Co., and the CERF.



Recording the Results

Once the test article was delivered to NTS and placed in position, final actions were taken on the various support elements. Ground shock gauges were placed in the soil. Final instrumentation hookups were made, camera towers were erected and stabilized and camera mounts were placed. Final construction was completed and the earth cover was placed over the steel structure. The earth cover is to delay the blast effect on the DABS facility. This helps contain the blast for a longer period of time so the proper pressure can build up and be realized inside the simulator. It is this pressure that creates the overpressure that reacts upon the test article. For the test, cameras are placed inside the article. Cameras

are also placed outside looking into the simulator and outside aimed at the simulator. Several cameras of various types are used to record the visual effects of such a test. Information captured on film provides a lot of good, useful data. Cameras with frame speeds ranging from 400 to 6,000 frames per second record various visual data used to analyze the effects of and reactions to the blast.

Several dry runs were performed before shot day to insure that all conditions were properly covered, that checklists were adequate, that procedures were correct and instrumentation

ABOVE: Soil overburden being placed over the DABS to help resist blast.
RIGHT: Results of the blast wave. Test model is located under pointed shadow.

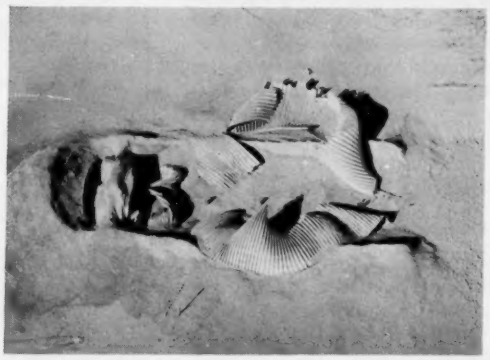
equipment was functioning properly. All of the instrumentation van equipment is operated by AFWL Civil Engineering Research Division technicians. AFWL has the largest blast and shock instrumentation recording capability in the Air Force. In addition, the test conductor was an AFWL engineer.

All explosives have now been placed, the firing harness has been built and the system is armed 45 minutes before shot time. Spectators are a mile away from the test area and include executives from some 60 contractors associated with the M-X missile system and the commander of BMO.

The Test

"-5,4,3,2,1 FIRE!" Flames and smoke bellow from the throat of the simulator as the soil on top of the simulator is blasted into the air. The recorded effects of the test are completed in less than 20 ms (20/1000 of a second). Quicker than one can blink, the environment has been created, and the test structure has responded accordingly. As the soil starts to rise off the metal shell, the test is over. All that is left are the visual spectaculars, the residue of the test. Dirt, smoke, and steel pieces bellow and spiral into the air. The blast rips the metal simulator open like it was unzipped at the top and waves it around like a flag.

After everything settles, safety personnel go in and check the area for unsafe conditions. Spectators are then allowed in to see the awesome ef-



fects of a simulated nuclear event. The door to the test article is cleared so the cameras can be removed. All film and data tapes are rushed to Kirtland for processing and reduction.

Data and pictures are reviewed / studied / analyzed to determine the effects on the structure. After much analysis, the results of the test are briefed to BMO. The results are eventually briefed to HQ USAF and DOD. From the results of these tests, come decisions which determine the mode of basing and possible location of placement of the weapon system.

The D-1 test was very successful. It provided a very high percentage of usable data; data provided by Civil Engineering Research Division, AFWL. Just another job done well for the Air Force.

E&S

Major Fred L. Hallberg *is chief of the test operations branch, Civil Engineering Research Division, Air Force Weapons Laboratory. He holds the bachelor's degree in construction from Arizona State University, Tempe, Ariz. earned in 1963.*

"... the workplace may be right in the middle of the mighty Yukon river (while frozen)"

Maintaining Top Cover For America

by Capt Patrick M. Coullahan

What is the optimal way to operate, maintain and repair the facilities at 15 active Air Force installations located throughout Alaska?

Don't answer yet, because there are some further considerations. The installations are remote, isolated, and—with a few exceptions—reachable only by water or air. Furthermore, in winter the installations are faced with persistent snowfalls, black ice, unbearable winds, unbelievable ice fog and whiteouts, permafrost, temperatures as low as -60° Fahrenheit, tundra, frozen equipment and long nights. On the other hand, the summer months bring mosquitoes, "no-see-ums," mud, floods, breakups, and "hot" weather.

The installations themselves date back to as early as 1942 (Galena airport), with the majority being constructed in the early to mid-fifties (aircraft control and warning stations).

Fire protection, prime heat and power, water and sewage treatment operations, airfield and road repairs, maintenance for the 550 plus facilities, and new construction are some of the key activities that must take place at these 15 locations spread throughout Alaska, some as far as 1,500 miles away from the Alaskan Air Command headquarters at Elmendorf AFB. Sounds challenging doesn't it?

Now that you have a rough idea of the parameters we would like you to consider the multifaceted Alaskan Air Command (AAC) approach to best performing the civil engineering mission and maintain facility readiness.

At the 12 ACW stations, most civil engineering functions are performed by a base operating support (BOS) operations and maintenance (O&M) contractor. This contractor (currently RCA-OMS of Camden, N.J.) is responsible for the O&M requirements as set forth in a 1977 statement of work (SOW) developed by Headquarters AAC. This SOW/contracting effort came about as a major recommendation in the 1975-1976 time period by the base management action group (BMAG).

The BMAG (headed by Maj Gen Robert C. Thompson when he was Director, Engineering and Services, Headquarters, USAF) had the goal of improving Air Force productivity by taking a look at what we were doing and determining how we could do it better. This productivity improvement could take several forms. In the case of the ACW stations, it took the form of quality of life—most notably by reducing the amount of military remote (and often undesirable) assignments. The broad-based application at the 12 ACW stations has led to a reduction of more than 5,000 remote military assignments in the past four years for civil engineering, services, transportation, supply, medical, security police, MWR (morale, welfare and recreation), weather, communications, administration, airfield operations, and disaster preparedness personnel. That is truly a noble achievement and a valuable step in improving the quality of life for the Air Force member.

At the ACW stations, all civil engineering plant operations, civil engineering services, and most maintenance and repair of facilities are accomplished by the contractor. However, not all ACW station civil engineering effort has been contracted. Key work is done by in-service civil engineering forces from a 200-member off-base civil engineering (OBCE) detachment of the 21st Civil Engineering Squadron with its home at Elmendorf AFB. The OBCE organization is quite similar to that of other base civil engineering organizations, but its mission is much more complicated and demanding than the standard BCE outfits.

OBCE is responsible for that work which is beyond the "capability" of the permanently assigned civil engineering workforce at the various remote locations. OBCE performs facility work of varying degrees for the three in-service remote base civil engineering (RBCE) units (Galena Airport, King Salmon Airport and Shemya AFB) and the 12 ACW contract units. Beyond the "capability" is usually defined as work requiring specialized skills, detailed planning/materials, and construction work. OBCE functions include aerial tramway, diesel generator, and hangar door maintenance repair; operating engineers, composite crafts, and equipment controls. These direct labor functions are in addition to the resources and requirements activities of planning, material control and production control, and the "hard-core" engineering function.

The OBCE operating engineers have the responsiblity for the execution of airfield repairs at the

gravel ACW runways, roadway repairs at all remote AAC operations, water and sewage treatment system repairs, aerial tramway and hangar door maintenance and repairs, pavements work, bridge and culvert repair and explosive demolition work. The equipment assigned OBCE operating engineers is mostly "air transportable," that equipment which will squeeze into a C-130 Hercules aircraft to make the always interesting flights to the remote AAC locations, where 4,000-foot gravel strips are the norm. The C-130 aircrews assigned to 616th Military Airlift Group must handle the super - challenging geographical considerations of flying in Alaska, and a lot of that flying is in support of OBCE operating engineers.

More than 60 pieces of heavy equipment, including dump trucks, concrete mixers, specialized rock crushing equipment, front end loaders, bulldozers, rollers, and scrapers make the Alaskan circuit to carry out OBCE's mission. For movement of "outsized" equipment, (air transportable equipment size limitations are: width, 111"; height, 108"; length, 450"; and weight, 28,000 lbs) a system known as COOL BARGE is sometimes used. COOL BARGE is a transportation and supply project established in 1956 and managed today by Air Force Logistics Command. It is designed to take advantage of the economy of large quantity procurement and transportation to deliver a year's requirement of bulk fuels and dry cargo to the remote installations throughout Alaska using cargo barges, a fuel barge, and numerous lighter barges and tugs to complete the annual requirement. Waterways used include the Bering Sea, the Yukon and Kuskokwim Rivers and the Pacific Ocean. Sparrevohn AFS and Indian Mountain AFS are only reachable by air.

A major drawback to extensive COOL BARGE use is time. You must know your requirements for construction equipment far in advance of use - and then be prepared to dedicate that piece of equipment for the length of the project. This commitment gives the obvious advantage for improved productivity afforded by using the big equipment versus the smaller "air transportable" equipment. The old timers sometimes fondly recall the heyday of the C-124 Globemaster and the C-133 Cargomaster with their outsized cargo capability enabling routine relocation of large construction equipment items within the Alaskan theater.

Some of the special requirements the operating engineers have capably completed are the extensive rebuilding of roads and culverts following the devastating 1977 Yukon River flood at Galena airport; cleanup requirements at Indian Mountain AFS following a fuel spill down the side of the mountain; cleanup at Cape Sarichef Radio Relay Site (RRS) after deactivation of the DOD long-line tropo-scatter White Alice Communications System (WACS); major airfield repairs to the gravel-surfaced runways at Cape Romanzof, Cape Newenham and Tatalina Air Force stations; and emergency snow removal at Cape Romanzof AFS when the ACW mission was in danger because of drifting snow preventing access to fuel facilities.

Keep in mind the OBCE operating engineers' work is almost always outside. The six personnel performing aerial tramway maintenance have to do it under sometimes harrowing conditions. Work must go on even though the workplace may be right in the middle of the mighty Yukon River (while frozen) or on the shoulder of steep mountainous roads. However, the majority of jobs the operating engineers perform are planned well in advance knowing the constraints of the Alaskan construction season. OBCE operating engineers annually do an incredible amount of work in an amazingly short period of time, using overhire personnel to take advantage of extended daylight hours.

The composite crafts include 120-plus personnel in the electrical, mechanical and structural fields. They undertake most major maintenance and repair of facilities and nearly all construction work at the remote AAC locations. Many times these teams are faced with highly unusual circumstances, not having the necessary materials, or new requirements. Jobs must be handled—and handled swiftly. Knowing the Alaskan environmental constraints, each job

BELOW: Tramway building at ACW station.

becomes a test of craftsmen's pride, ingenuity and ability. For example, reinsulating the water tanks located on the side of a mountain at Cape Romanzof AFS is difficult, but it gets done. Painting, exterior electrical and roofing jobs often put the OBCE composite crafts personnel into some breathtaking vantage points for viewing the scenery of Alaska.

Typically, crews will consist of a working leaderman, an electrician, a carpenter, a pipefitter and the like. The military assigned are typically "three" or "five" level personnel. These crews are always in some phase of the learning mode, whether it be a hardcore skill requirement, or an ancilliary requirement. They rely heavily on the abilities of the resources and requirements (R&R) personnel in OBCE. R&R provides the planning, materials ordering and appropriate delivery to the sites, and production control in the form of acceptance of work requests and workforce scheduling for OBCE. When you talk about the millions of dollars used for OBCE materials, the controlled delivery of materials to 15 district locations, and the eventual application of the materials to the job—you are talking about a tough task.

The plans of OBCE R&R get a true workout. The results of the combined efforts of the composite crafts and R&R are fascinating and exciting, particularly in the dining halls and dormitories. Many energy saving projects at remote locations have also been accomplished by the composite crafts, such as increasing insulation and lowering ceilings, installation of more energy efficient lighting, and installation of a waste heat system for a large warehouse at Shemya AFB. These jobs were in addition to the out-of-the-ordinary repairs made following severe winter storms, fires, and damage to utility systems following freeze/thaw conditions. Working closely with the composite crafts personnel are the highly specialized individuals handling control systems throughout the Alaskan remotes. They work on all types of controls, alarms, safety systems and fire protection systems. One very interesting accomplishment was the installation of automation at the top camp fuel storage transfer system at Indian Mountain AFS. This system has the capability to provide immediate, positive indications of other than normal conditions occuring in the 400,000-plus-gallon fuel system.

The most traveled function within OBCE is the diesel maintenance shop. The more than 40 military and civilian personnel assigned perform depot level maintenance on all fixed power generation equipment, and depot and field level maintenance on portable power generation equipment keeping more than 300 power generators throughout AAC in operational condition. These generators include the mighty 3,000 KW Cooper-Bessemer 16-cylinder (each one with a 15-inch diameter) diesel generators at Shemya AFB and the numerous 30-year old Cummins generators providing prime power at many of our ACW stations. The huge amount of supplies and equipment needed to keep the generators smoothly ticking are expeditiously moved throughout the Alaskan theater using the now famous "pink box" approach—making the items readily identifiable no matter where they are in the logistics chain. Not only do the tools, equipment, supplies and manpower mesh at their required locations for scheduled work, but also the OBCE diesel maintenance shop has been able to provide superior unscheduled repair service wherever and whenever needed.

The OBCE management must ensure the numerous work tasks are accomplished without ignoring the necessary paperwork. Hundreds of travel orders are needed annually, and the bush airlines are kept very busy shuttling OBCE workers. Although paperwork is minimized, followup in the form of trip reports becomes critical information for future visits and for the personnel at the location visited and continued facility readiness.

At the three large remote installations (Shemya AFB, Galena airport, King Salmon airport) primary civil engineering operations, maintenance and repair activities are performed in-service. Military and civilian personnel are permanently assigned in-place to perform crash, rescue, and fire services; to operate utility and aircraft arresting systems, and perform emergency and urgent maintenance and repair to the facilities. These permanently assigned work forces are kept to a minimum in an effort to perform essential services when required while keeping undesirable military remote assignments to the lowest level possible.

In 1979, the AAC staff performed a study to best determine the way to perform all support activities at Shemya AFB, Galena airport and King Salmon airport. A remote minimum manning concept for these in-service operations was developed. This concept was implemented and reduced approximately 80 remote civil engineering tours yearly. The major ingredients were:

- **Implementation of a 48-hour work week for all military and civilians assigned.**
- **Transferring all nonrecurring, routine work requirements to OBCE.**
- **Implementation of improved verbal and written communications between OBCE and the RBCEs.**
- **Eliminating nonessential administrative tasks that did not need to be done at remote locations, or could be performed elsewhere.**
- **Employing civilians with diversified skills.**
- **Using overhires for peak workload.**
- **Using OBCE to provide TDY support for remote base temporary vacancies.** This is a most important ingredient, as the RBCE units are only one-deep in certain critical positions, such as liquid fuels maintenance, plumbing, electrical and refrigeration—so backfill is necessary, and expected. Also, plant operations, such as prime power and heating

must be performed continuously and require a minimum number of operators at all times lest the mission and readiness be affected.

• **Using the engineer-manager concept.** The use of OBCE engineer-managers became an important part of the concept. The lieutenants and captains assigned to this function become the continuity and professional engineering link the RBCE organization requires. The engineer-managers head up OBCE work identification and survey teams which travel to the remote locations on a regular basis. On those trips, they brief commanders and major customers on the status of current work, ascertain customer's future needs, perform required facility surveys, review previous work plans and review materials on station to determine if they are adequate to perform the OBCE tasks. This prevents wasted trips on the part of the OBCE craftsmen.

On occasion, the engineer-managers take on once-in-a-lifetime tasks. One such task is underway. An OBCE team is surveying deactivated WACS sites for hazardous materials which may have been left behind. The hazardous materials discovered will be removed or neutralized by OBCE at 26 separate WACS installations which are now closed. This action should indicate the AAC and USAF commitment to keep the environment safe from the problems hazardous materials could create.

The RBCE units are constantly challenged by the often adversary role of the elements in Alaska. For example, fighter intercepter aircraft stationed at Galena and King Salmon make nearly 300 engagements of the aircraft arresting systems yearly because of short runways and ice or snow-slick surfaces. The often rock-bottom temperatures at Galena test the capability of the central heating plant and distribution system, and the ever present high winds and squalls at Shemya always give the structures shop personnel something to think about. The maintenance of the base POL systems and the annual resupply requirements place large responsibilities upon the RBCE personnel. The all-military fire departments must be ever alert because of the tricky airfield characteristics and the old wooden facilities which are excessively dry from the many years of exposure to low winter humidity. Firefighting at super cold temperatures is something no one wants to try. Water and waste utility operators face and routinely overcome some of the toughest physical obstacles to inhabiting in the wilds of Alaska. Even disposal of wastes tests the RBCEs. Frozen ground in the far north certainly takes its toll on the RBCE equipment. Snow removal accomplishment and monitoring by the RBCEs have a most direct mission effect. All challenge our readiness capability.

In most instances, the officer assigned as the remote base civil engineer is usually performing the BCE role for the first time and does not come on board with a detailed knowledge of all the RBCE's requirements. Each RBCE normally goes through the "learning curve" process, and management "on-the-job" training comes quickly. At the end of a one year tour, the Air Force has a confident, proven civil engineering officer ready for increased responsibility—truly a valuable resource in this day of the shortage of qualified civil engineering officers. We believe few jobs in Air Force civil engineering can match the level of responsibility AAC RBCEs have at this early a point in their careers. The long-term payback of this individual's one year investment is increased readiness capability.

This also holds true for the enlisted civil engineering personnel assigned to RBCE organizations. Often these five-level personnel are handling requirements normally filled by much more experienced individuals. They have no one to fall back on, and must become the local expert in their particular skill. The relatively few civilians assigned provide the continuity needed to operate the bases with most military involved in some form of hands-on training. It's not unusual to see an airman first class responsible for power plant operations or handling the crew chief job on a crash vehicle. And they thrive on it!

The Alaskan solution to the civil engineering requirements is a delicate weaving of contractor personnel, roving in-service personnel, and permanently assigned remote in-service personnel who work together to better serve the mission and perform people projects within the given constraints. We feel our approach is streamlined, and could be likened to the proven productive ways Eglin AFB handles its auxiliary fields and ranges, and the San Antonio Real Property Maintenance Agency (SARPMA) performs its tasks. We believe the techniques in AAC are adequate to meet current mission needs and readiness commitments, but we know we face major changes in the future with the minimally attended radar (MAR) facilities phasing in and ACW facilities phasing out. We have already assessed the future by developing a SOW and manning model for civil engineering at the MAR sites based upon our desired physical plants. This long-range planning should aid in the transition to the MAR sites and continue the sound reputation of performance the civil engineering troops have established throughout the years in Alaska. AAC is ready and capable of maintaining top cover for America. YOU CAN COUNT ON IT!

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READINESS

"THE ABILITY TO FIGHT & WIN"

by Maj Dean Bartel

READINESS depends highly on survivable facilities to protect weapons systems and sortie generation personnel and equipment. To that end USAFE is aggressively constructing protective facilities to counter the increasing Soviet threat in Western Europe.

Blast effects alone no longer define the threat. We must now add chemical warfare protection to our facilities for survival of not only command and control of the aircraft mission, but all essential support elements as well. Ground security, intelligence, medical treatment, communications, aircraft maintenance and refueling, rapid runway repair, and other tasks must take place in the wartime environment.

Specialized Semihardened Facilities

USAFE civil engineers are designing many levels of protection for these critical functions. They range from "splinter" (shrapnel and flying debris) protection (such as the familiar revetment), to semihardened structures and beyond. For example, semihardened construction criteria includes as a minimum:

- 65 cm thick reinforced concrete walls and ceilings
- Armor plated doors
- Air locks on entrances
- Blast valves
- Standby power.

The criteria seem relatively straightforward, don't they? Not so! The USAFE engineer must deal with dual design and funding criteria, both NATO and U.S., to bring a facility design into reality. Where NATO technical criteria are insufficient the designer must provide justification. This can be through analysis or field testing to illustrate what is needed to meet an increased threat level; detailing the needs of a new weapons system; adapting to an advance in technology, or a mission enhancement.

Instead of expounding the virtues of the best-known semihardened facility, the aircraft shelter, this article will focus on facilities protecting specialized missions, describe structures on the drawing board, and conclude by detailing facility related programs such as chemical warfare protection and in-shelter refueling.

Operations Support Center

The operations support center at Ramstein AB, Germany, houses key contingency support agencies for USAFE. Readiness centers merged in the battle staff include: engineering and services, logistics, personnel, and joint rescue. Communications, weather, airlift control, medical evacuation, and joint medical control functions are also directed from here.

To provide the necessary physical protection the buried structure was covered with an extensive rock rubble overlay. Engineers included hardened protection for personnel entrances and a chemical decontamination cell. (See **Wartime Survivable Engineering and Services Command and Control** by Lt Col Richard J. Bergholz, page 30.)

Allied Tactical Operations Center

Another key hub during a European contingency is the allied tactical operations center at Sembach AB, Germany, which provides the command and control of tactical aircraft in the Central European region. Intelligence, plans, operations, communications, weather, automatic data processing, and Worldwide Military Command and Control System capabilities are also integrated into this facility.

Chemical protection within the facility is provided by air filtration systems. Internal pressurization prevents chemical migration into occupied zones. Special air blast valves protect all external openings, and an internal steel plate shields the work areas from both electromagnetic pulse (EMP) and concrete spall. The overburden includes both earth fill and a concrete buster slab, explained later in the article.

Avionics Maintenance Facility

What has been done for the more typical facility support requirements for the air combat mission at USAFE main operating bases? — Wing and squadron operations? Ready crews? And avionics maintenance? For example, the avionics maintenance facility affords physical and

chemical protection for the people who maintain and calibrate the various weapons component systems. Of note is the natural shielding of primary building entrances by protected vehicle driveways. Overburden in this case includes earth fill and a buried concrete burster slab.

Future Semihardened Facilities

To enhance our total base and mission survivability USAFE has planned semihardening for many new facilities. Protected munitions maintenance control facilities will provide command centers to direct aircraft, munitions and ground equipment maintenance. A proposed facility for the storage of war readiness spares kits and base level supply sets will provide protection for high-use aircraft parts essential to sortie generation and wartime operations. A planned mini-fabrication shop will house a structural repair and parts fabrication area for returning battle damaged aircraft to a combat capability. Numerous POL truck shelters have already been constructed.

Have we forgotten about "people protection?" Not at all. The complete USAFE plan includes casualty treatment, collective protection, and base recovery after attack.

Facility Related Survivability

Since the complete protective facility plan is not economically achievable soon, what is being done in the interim? By site-adapting mobile decontamination units, replanning space within existing aircraft shelters, and adding protection to in-place structures, USAFE civil engineers are stretching the construction dollar to fill the void.

KMU-450 Chemical Protection Unit

The most significant deficiency in NATO criteria is the complete exclusion of chemical warfare protection. So we have merged a transportable decontamination unit — designated the KMU-450 — into facilities critical to the USAFE mission. In this way we can expand operations in a contingency scenario.

KMU-450 shown inside aircraft shelter.

The unit supplies pressurized, clean air in an otherwise contaminated environment. It consists of a service module decontamination area and a variable number of filter/blower units to pressurize both the module and the controlled field structure.

In a contingency operation an individual would enter the service module airlock from a general contamination control area. After undressing, disposing of contaminated clothing and protective gear, showering, and receiving fresh clothing, the user could either enter the controlled field structure via flexible tunnels from the service module, or don new protective gear and return to the field.

The KUM-450 may be installed inside or outside the shelter. When installed within a shelter:

- **Shrapnel and liquid hazard protection is afforded.**
- **A protected contamination control area is provided in the forward portion of the shelter.**
- **Utilities and mechanical systems are already available in the shelter.**
- **The required overpressure is easier to attain.**

A KMU-450 installation **outside** an aircraft shelter increases the chemical protection area by some 100 to 150 per cent, however:

- **Personnel in the contamination control area are exposed.**
- **The KMU-450 is highly susceptible to shrapnel and debris damage.**
- **The unit was not designed for a liquid chemical hazard.**
- **The required revetments boost project costs.**
- **Aircraft shelter doors are manhour intensive to seal.**

- **The integrity of the seal under a near miss blast overpressure is uncertain.**

The KMU-450 entered the Air Force inventory in 1977 and immediately underwent extensive evaluation at the then-Civil and Environmental Development Agency at Tyndall AFB, Florida (now the laboratory element of AFESC/RD). In early 1981, 819 CES (HR), RED HORSE personnel completed the first field installation at Ramstein AB. Its successful testing started the rapid beddown of some 61 units in USAFE, with completion expected in late 1982. Thirty-three are being installed using $1.1 million in FY 1981 O&M money, and the remaining 28 are included in the FY 1982 military construction program at $1.6 million.

Maximum Aircraft Shelter Utilization

Other options have been pursued for existing semihardened shelters to make the mission more survivable. By suspending extra fuel tanks from the shelter walls and pre-positioning missile racks and air-to-ground munitions within the shelters, more equipment is protected. Aircrews can stand alert for extended periods in personnel cubicles — mobile home type structures — inside the protected shelter.

A recent innovative in-shelter refueling concept developed within USAFE dramatically increases system survivability replacing the vulnerable truck refueling operation. It includes standard semihardened storage tanks and a bi-directional flow pipeline, with valves to isolate damage. A pipe extending into each shelter feeds a pantograph dispensing system. As a result aircraft maintenance, refueling, and munitions loading can be accomplished simultaneousiy in the protected confines of the shelter. This concept was validated by USAFE engineers in September 1979 demonstrating a prototype at Spangdahlem AB, Germany. A NATO engineering safety panel later developed the necessary flammability and toxicity standards. NATO is considering a formal proposal to designate the system a minimum military requirement making it eligible for NATO funding.

Burster Barriers and Rock Rubble Overlays

Burster barriers — ground surface concrete slabs — and rock rubble overlays are adding penetration protection to our buried structures. These barriers and overlays deflect, defuse, or predetonate a weapon before it can penetrate the facility. This concept holds the greatest potential for buried command and control facilities and is being considered for use throughout USAFE.

Tonedown and Deception

USAFE's main achievement in airfield deception has been its paint tonedown program to reduce visual target acquisition of airfield pavements and base facilities. Effectively complementing USAFE's airfield tonedown, the Military Airlift Command has camouflaged its airlift aircraft. Other deception measures underway include reforestation, camouflage netting, smoke obscuration, and decoys.

Limits and Needs

Funding is a key restraint in carrying out the USAFE protective structure (survivability) plan. NATO provides resources for **physically** protecting some facilities, but funds no chemical warfare protection. We are competing with our fellow armed services for limited MCP resources. The passive requirements for aircraft shelters alone exceed $1.5 million.

Integrated facility planning is also essential. The development of systems must be related to the facilities needed to launch, recover, and support aircraft.

Let's also not forget the research needs for:

- **New materials**
- **Definition of loads**
- **Simplified analysis and design**
- **Behavior of structural components**
- **Hardware evaluation**
- **Chemical protection**

These efforts must proceed at a pace commensurate with the needs of the systems being developed.

Summary

We have made substantial progress increasing the survivability of our forces in USAFE. Our aggressive program to provide upgraded physical and chemical protection is moving well. Recent successes in getting tomorrow's facility requirements into the Program Objective Memorandum are very encouraging. READINESS — the ability to fight and win — remains our foremost objective. Survivability is important to each and enhances our readiness capability.

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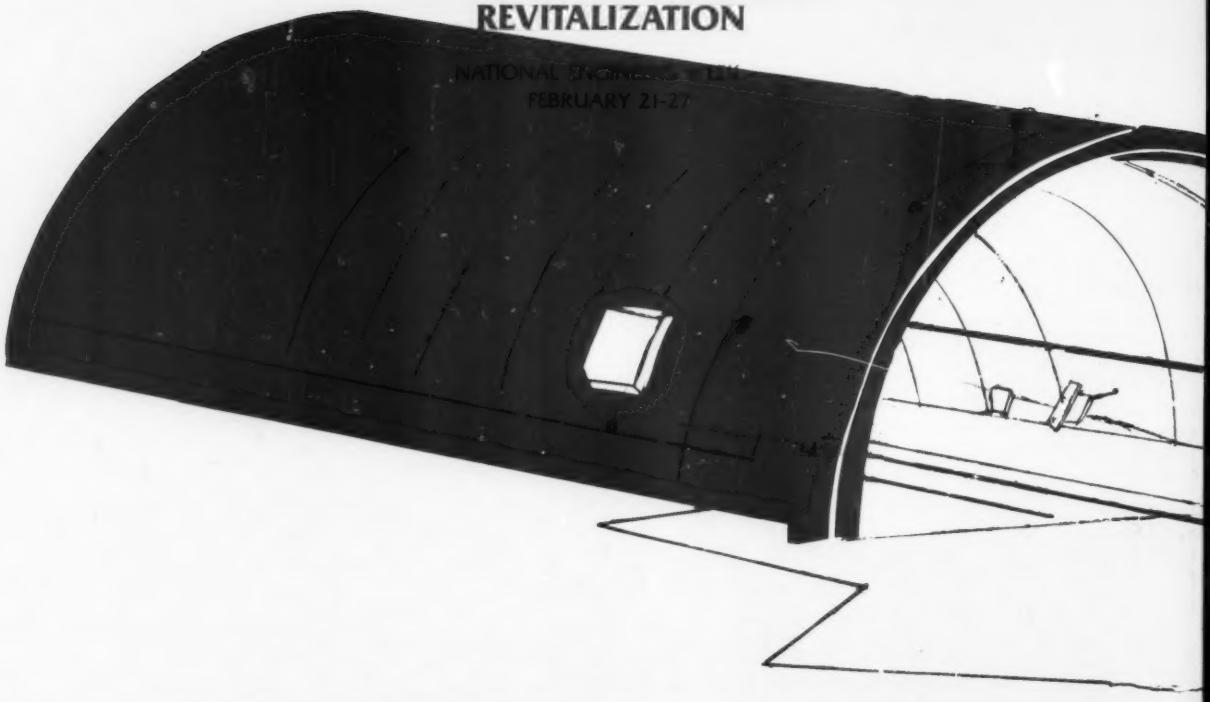

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